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# AQUATIC BIOPHYSICAL INVENTORY OF MAJOR TRIBUTARIES IN THE AOSERP STUDY AREA VOLUME II ATLAS

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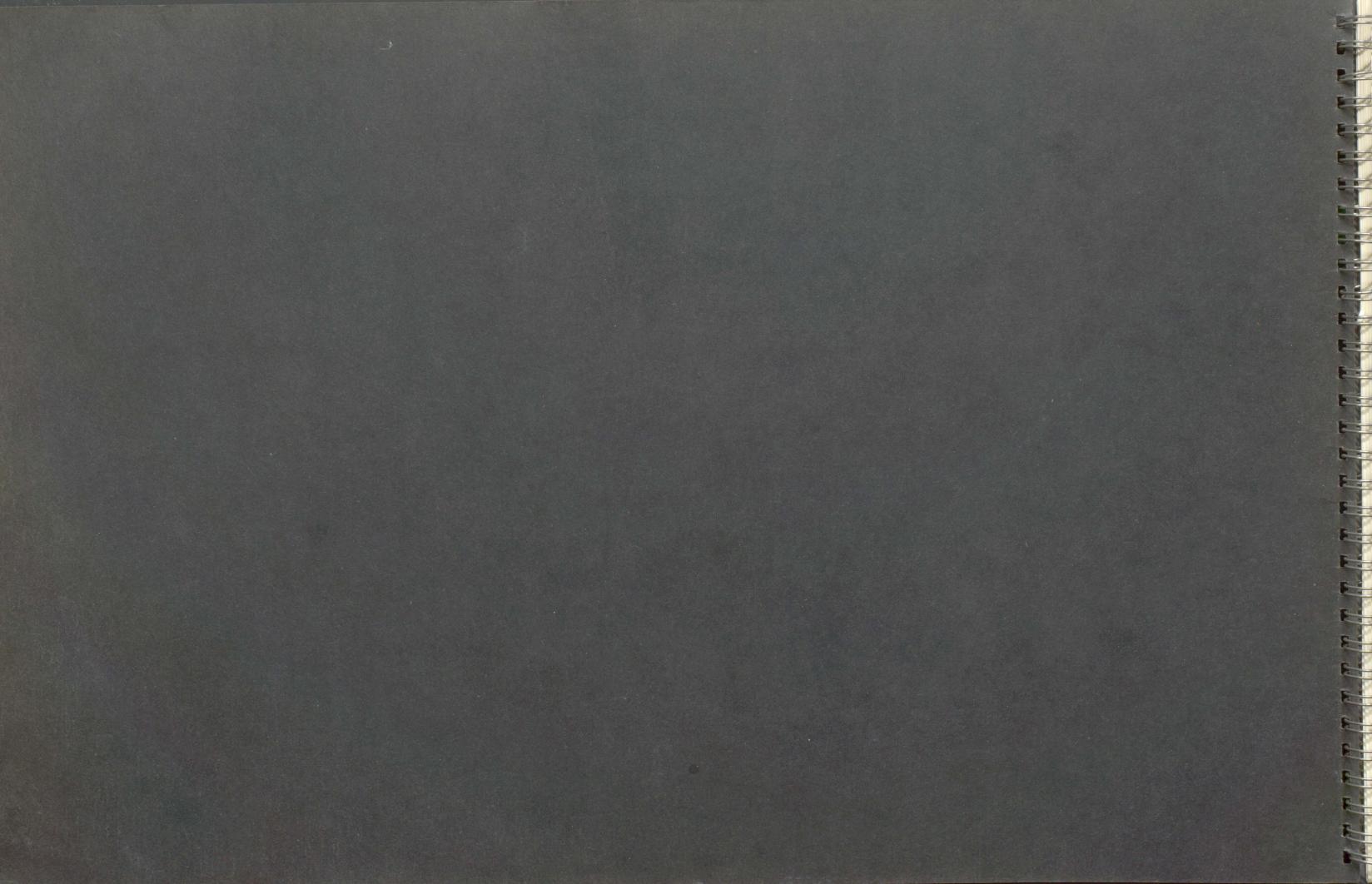
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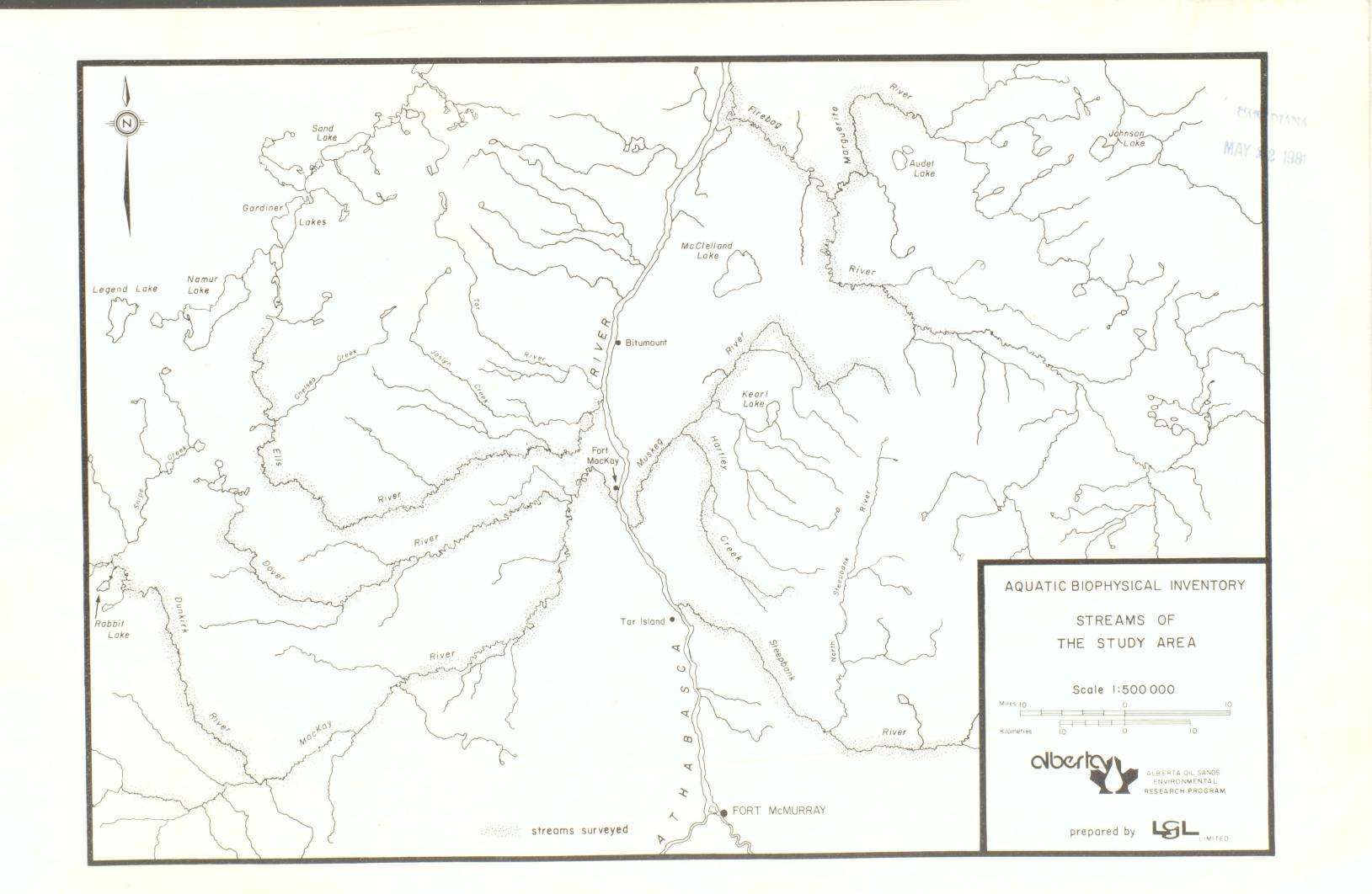
for



ALBERTA OIL SANDS ENVIRONMENTAL RESEARCH PROGRAM

Project WS 3.4 April 1980



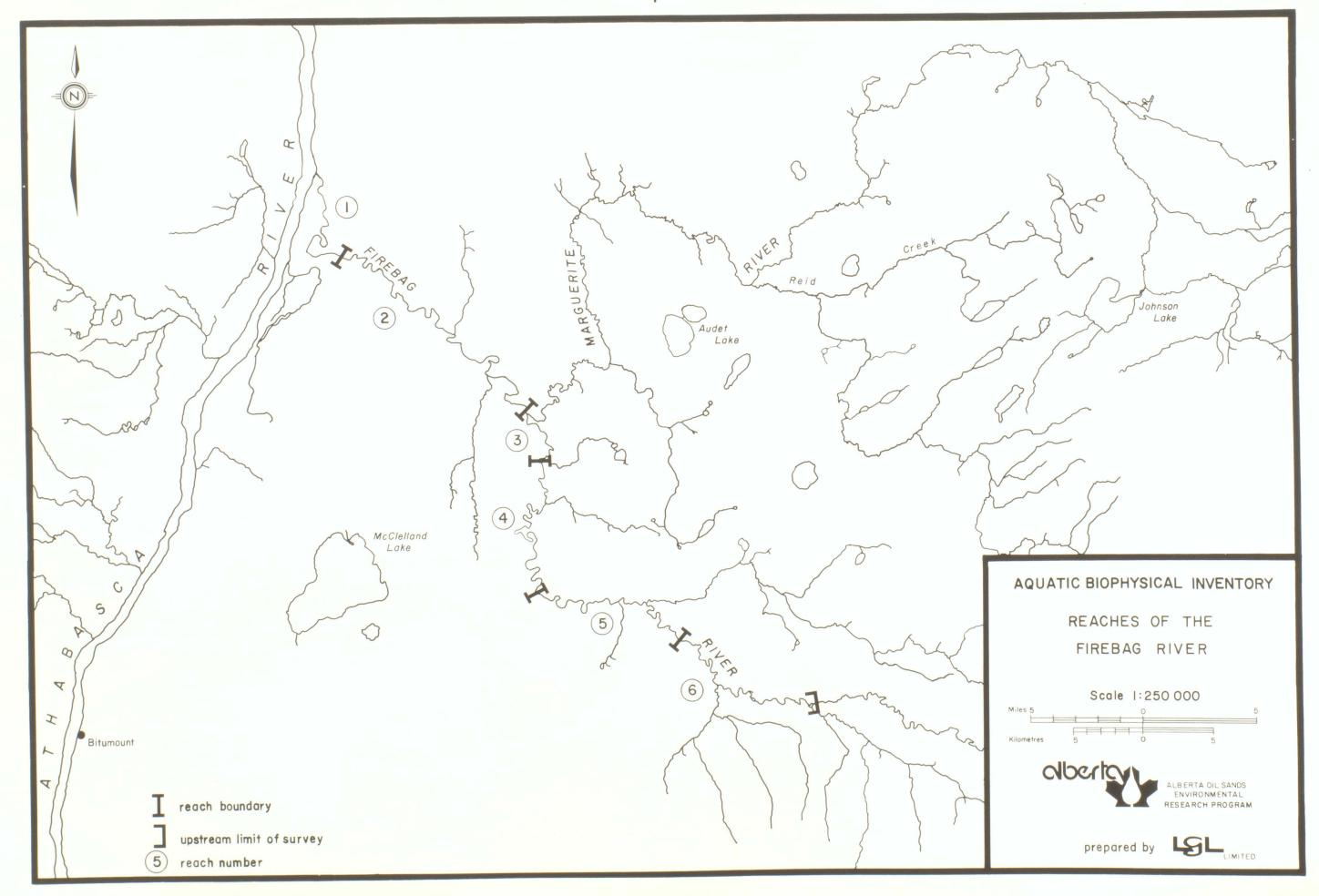


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# FIREBAG RIVER



	Adults		Juveniles and Young-of-the-year		Total Numbers	
Species	May	September	May	September	May	September
lake chub	ND	0	ND	3	ND	3
lake whitefish	ND	22	ND	1	ND	23
longnose sucker	ND	2	ND	0	ND	2
northern pike	ND	1	ND	0	ND	1
walleye	ND	2	ND	2	ND	4
white sucker	ND	1	ND	0	ND	1
Total	ND	28	ND	6	ND	34

### PHYSICAL CHARACTERISTICS

Reach length (km)	13.	. 0
Channel width (m)	95	
Channel area (ha)	123.	. 5
Gradient (m/km)	0	. 3
Flow character	swirling,	rolling
Total pools (%)	90	
Pattern	irregularly	meandering
Confinement	unconf	fined
Unstable banks (%)	40	
Substrate composition (%)		
fines (<2 mm)	95	
gravels (2-64 mm)	5	
larges (>64 mm)	0	
bedrock and/or oil sand	0	
Debris	lov	V

### REACH DESCRIPTION AND FISH UTILIZATION

This reach, which lies largely within the Athabasca River floodplain, is irregularly meandering and has many areas of unstable banks. Water levels and flow in at least the lower portion of this reach are affected by water level fluctuations in the Athabasca River. Gradient and water velocities in this section are the lowest in the studied portion of the Firebag River. Water flow is primarily swirling and a high proportion of the reach is composed of pools. The substrate is almost entirely fines. Although deciduous shrubs are an abundant component of the riparian vegetation, little of this growth overhangs the channel.

Morthern pike, which were captured in this reach, and brook and ninespine stickleback, which were captured further upstream in the Firebag River, may spawn in the occasional grassy shallows along the banks within this reach. Adult lake whitefish, captured in this reach during autumn, may also spawn here. Although lake whitefish prefer to spawn over rocky substrates, they will spawn over sandy substrates. Several forage fish species (e.g., trout-perch and pearl dace) that spawn over sandy substrates were captured within other reaches of the Firebag River; they may spawn in this reach. The reach is considered to be a relatively good rearing area for fish because of the slow waters and the presence of log debris and grassy shallows within which young fish may take refuge. Log jams, overhanging banks, and the many deep pools provide excellent resting and feeding areas for adult fish of larger piscivores such as walleye and northern pike. The many pools and relatively deep water in the reach provide abundant overwintering areas for fish.

### BENTHIC INVERTEBRATES

No benthic samples were taken in this reach.

R	I	PAR	IAN	VEGETATION
	_			

Bank coverage (%) Coniferous trees 30 Deciduous trees Shrubs 10 Grasses Barren Channel cover (%) Overhang Crown

### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

### STREAM GAUGING DATA

No data available for this reach

Water Survey of Canada station number 00AT07DC0011

	Mean	Maximum	Minimum
Total alkalinity (mg CaCO <sub>3</sub> /1) pH	111.7 7.77	129.2 7.89	7.68
Total hardness (mg CaCO <sub>3</sub> /1)	108.5	124.0	94.1
Conductance (µS/cm)	198	231	171
Total filterable			
residue fixed (mg/1)	110	130	100
Total non-filterable residue fixed (mg/l)	6	13	< 0.4
Total organic carbon (mg C/1)	9.2	11.0	7.0
Silica (mg SiO <sub>2</sub> /1)	11.8	16.0	9.7
Nitrate and nitrite nitrogen (mg N/1)	0.046	0.090	< 0.003
Total Kjeldahl nitrogen (mg N/1)	0.95	1.07	0.82
Total Phosphorus (mg P/1)	0.044	0.051	0.034
Orthophosphate (mg P/1)	0.013	0.016	0.010
Sulphate (mg SO <sub>4</sub> /1)	3.0	5.0	0.1

Data for the period January 1976 to December 1977 obtained from the National Water Quality Data Bank (NAQUADAT).

Slow-moving pool conditions at km 5.

Swirling flow at km 9 is typical of reach 1.

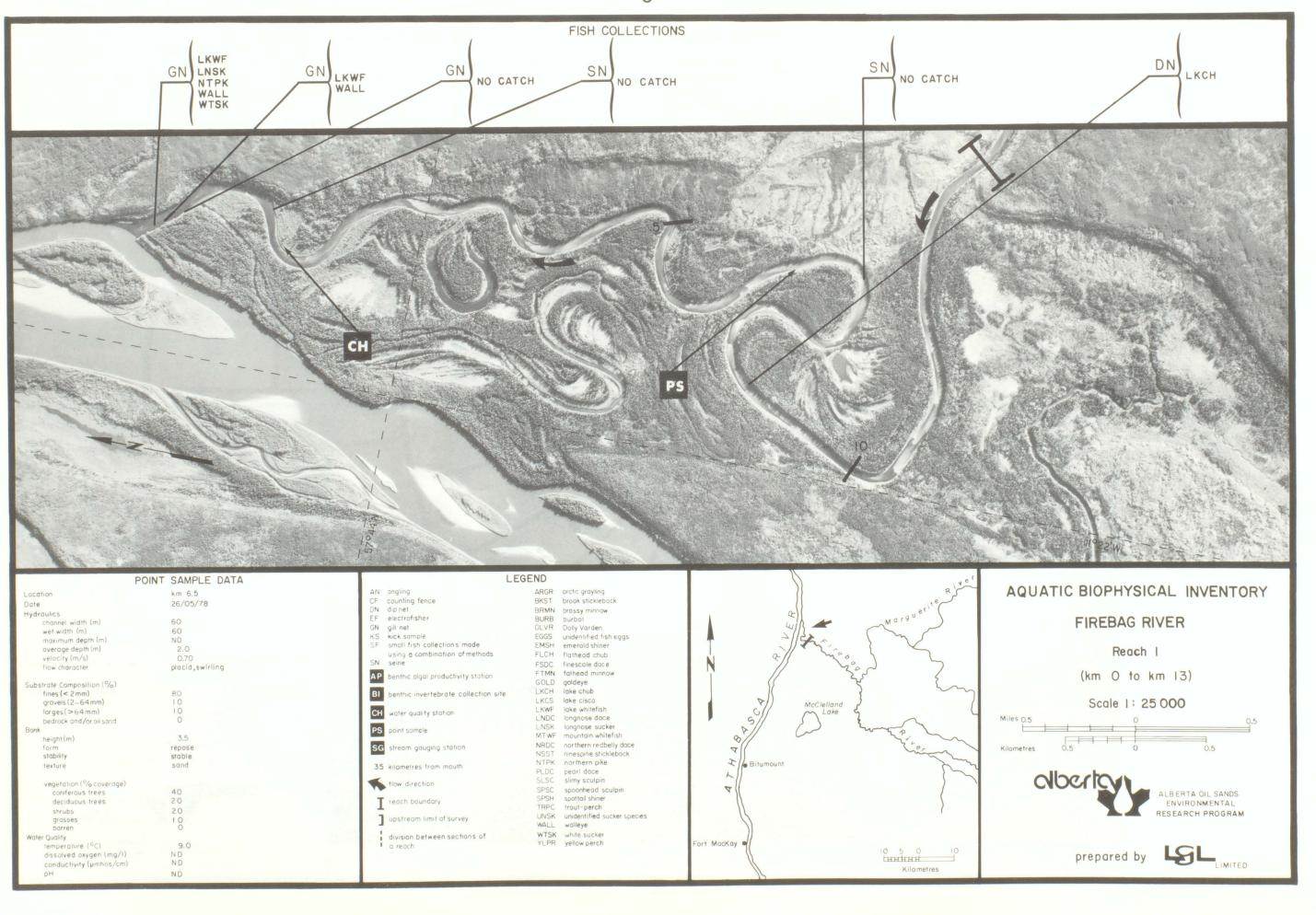
# AQUATIC BIOPHYSICAL INVENTORY FIREBAG RIVER

Reach I (km O to km 13)



ALBERTA OIL SANDS ENVIRONMENTAL





	Adults		Juveniles and Young-of-the-year		Total Numbers	
Species	May	September	May	September	May	September
arctic grayling	0	0	1	0	1	0
brook stickleback	0	0	1	0	1	0
lake chub	0	0	37	0	37	0
lake whitefish	0	3	0	0	0	3
longnose dace	0	0	30	0	30	0
longnose sucker	0	0	0	1	0	1
pearl dace	0	0	11	0	11	0
slimy sculpin	0	0	9	2	9	2
walleye	0	1	0	0	0	1
white sucker	0	1	73	0	73	1
Total	0	5	162	3	162	8

### PHYSICAL CHARACTERISTICS

Reach length (km)	32.5
Channel width (m)	80
Channel area (ha)	260.0
Gradient (m/km)	0.6
Flow character	swirling, rolling, broken
Total pools (%)	90
Pattern	irregularly meandering
Confinement	confined
Unstable banks (%)	25
Substrate composition (%)	
fines (<2 mm)	70
gravels (2-64 mm)	25
larges (>64 mm)	3
bedrock and/or oil sand	2
Debris	low

### REACH DESCRIPTION AND FISH UTILIZATION

This reach is located above the Athabasca River floodplain and is irregularly meandering with some near-vertical cut banks up to 40 m high. Areas with unstable banks are common. Gradient and water velocities are greater than those in Reach 1 but lower than those in upstream reaches of the Firebag River. The water is moderately deep and although some rapids are present, pools comprise most of the total reach area. Flow character is mixed, with swirling, rolling and broken waters. Fines comprise the majority of the substrate. Coniferous and deciduous trees predominate in the riparian vegetation and there is no overhanging

Lake whitefish and a few of the forage fish species captured in the Firebag River that spawn over sandy substrates may spawn in this reach. Limited spawning of other fish species that normally spawn over gravelly substrates may also occur. Because of the relatively low water velocities and presence of debris, the rearing potential for fish is considered to be moderate. During the spring, moderate numbers of young lake chub, longnose dace and white sucker were captured. The presence of these smaller fish suggests that there is at least some feeding potential for northern pike and walleye in this reach. The many pools and moderately deep waters provide resting and feeding areas for adults of larger fish and also provide good overwintering areas.

### BENTHIC INVERTEBRATES

GASTROPODA

Gyraulus

PELECYPODA

Musculium Sphaerium

INSECTA

Ephemeroptera Baetis Ephemerella Paraleptophlebia Stenonema

Odonata

Plecoptera Isoperla Pteronarcys

Trichoptera Cheumatopsyche Hydropsyche Lepidostoma

Oecetis Polycentropus Psychomyia

Diptera Tipulidae Ceratopogonidae Chironomidae Chironominae Tanypodinae Orthocladiinae Simuliidae Tabanidae Rhagionidae

Empididae

### RIPARIAN VEGETATION

Bank coverage (%) Coniferous trees Deciduous trees 35 Shrubs Grasses 20 Barren Channel cover (%) Overhang Crown

### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

### STREAM GAUGING DATA

Water Survey of Canada station number 07DC001

Maximum total annual discharge: 1075.6 x 10<sup>6</sup> m<sup>3</sup> (1975) Minimum total annual discharge:  $341.7 \times 10^6 \text{ m}^3$  (1976) Maximum annual mean discharge: 33.98 m<sup>3</sup>/s (1975) Minimum annual mean discharge: 21.72 m<sup>3</sup>/s (1976) Maximum monthly mean discharge: 97.13 m<sup>3</sup>/s (August 1973) 7.08 m<sup>3</sup>/s (February 1972) Minimum monthly mean discharge: 238.14 m<sup>3</sup>/s (Aug. 10, 1973) Maximum daily discharge: 6.94 m<sup>3</sup>/s (Feb. 10, 1978 Minimum daily discharge:

Data for 1971 to 1978 compiled from Loeppky and Spitzer (1977), Warner and Spitzer (1979) and Warner (1979).

### WATER QUALITY

Water Survey of Canada station number 00AT07DC0010

	Mean	Maximum	Minimum
Total alkalinity (mg CaCO <sub>3</sub> /1) pH	111.0 7.70	219.0	43.2
Total hardness (mg CaCO <sub>3</sub> /1)	112.0	227.0	63.9
Conductance (µS/cm)	208	433	105
Total filterable			
residue fixed (mg/1)	105	149	60
Total non-filterable			
residue fixed (mg/1)	L <sub>4</sub>	56	< 0.4
Total organic carbon (mg C/1)	11.0	24.5	1.0
Silica (mg SiO <sub>2</sub> /1)	13.1	29.6	6.6
Nitrate and nitrite nitrogen (mg N/1)	0.080	0.400	< 0.003
Total Kjeldahl nitrogen (mg N/1)	0.89	5.40	0.20
Total Phosphorus (mg P/1)	0.050	0.180	0.023
Orthophosphate (mg P/1)	0.020	0.060	0.005
Sulphate (mg SO <sub>4</sub> /1)	4.7	17.5	0.1

Data for the period January 1976 to December 1979 obtained from the National Water Quality Data Bank (NAQUADAT).



Broken waters at km 28.5.

Swirling pool conditions, typical of reach 2, at km 36.

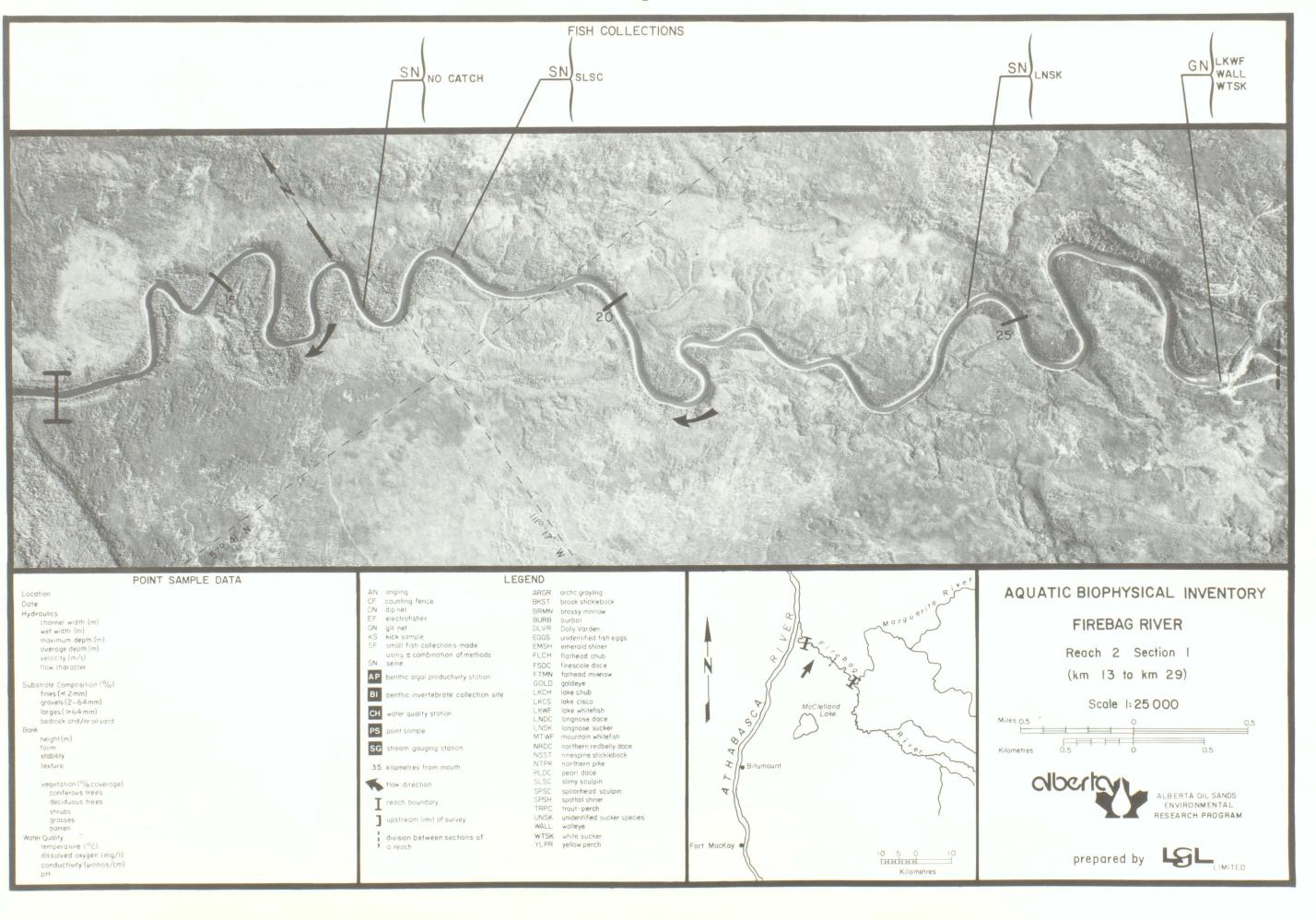
# AQUATIC BIOPHYSICAL INVENTORY FIREBAG RIVER

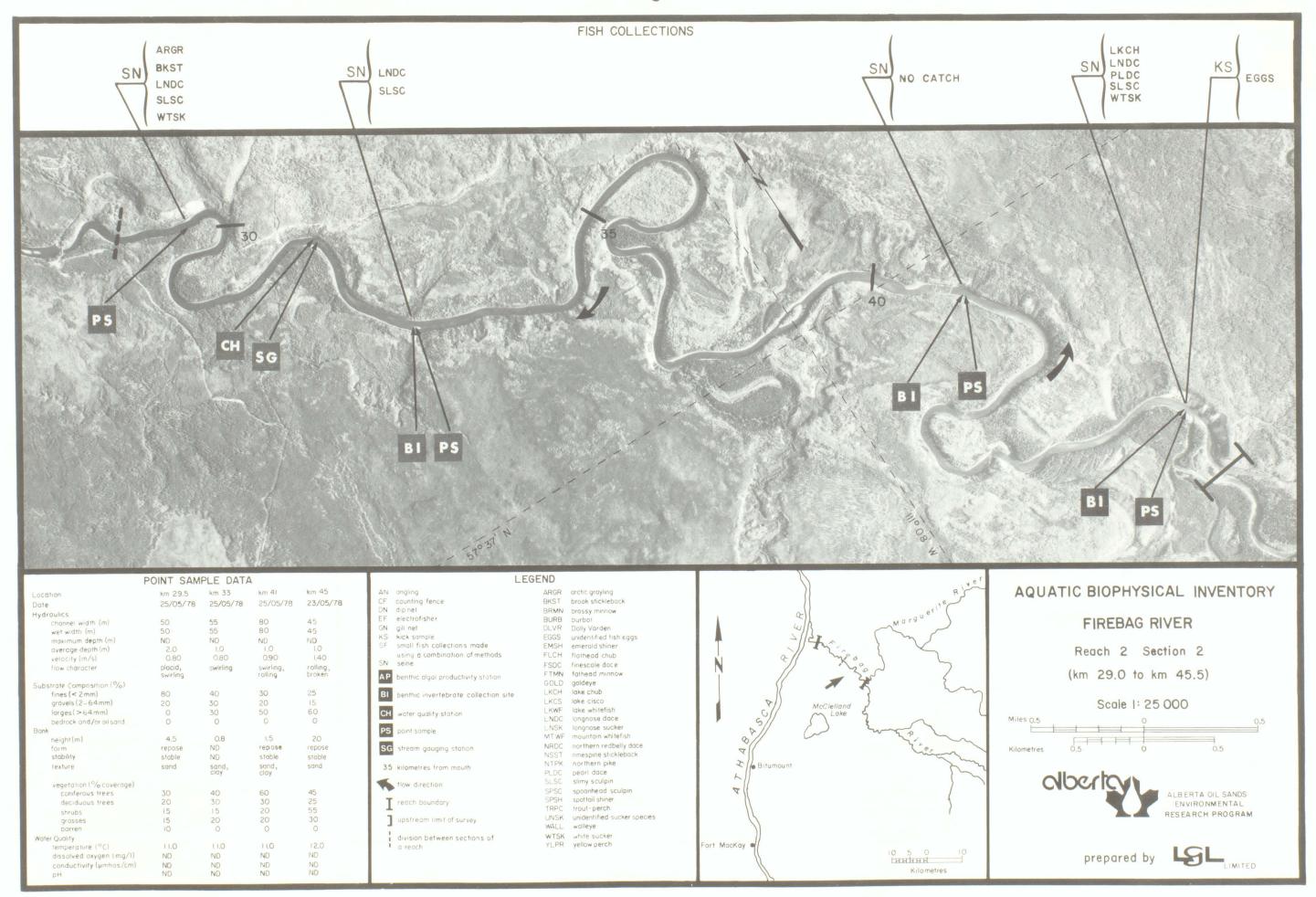
Reach 2 (km 13.0 to km 45.5)



ALBERTA OIL SANDS ENVIRONMENTAL RESEARCH PROGRAM

prepared by LSL LIMITED





	Adults		Juveniles and Young-of-the-year		Total Numbers	
Species	May	September	May	September	May	Septembe
arctic grayling	1	1	1	0	2	1
lake chub	0	0	136	381	136	381
longnose dace	0	0	0	19	0	19
longnose sucker	5	1	56	10	61	11
northern pike	0	2	0	0	0	2
pearl dace	0	0	13	0	13	0
slimy sculpin	0	0	0	3	0	3
trout-perch	0	0	11	0	11	0
unidentified suckers	0	0	0	20	0	20
white sucker	0	0	251	27	251	27
Total	6	4	468	460	474	464

### PHYSICAL CHARACTERISTICS

Reach length (km)	6.5
Channel width (m)	45
Channel area (ha)	29.3
Gradient (m/km)	1.9
Flow character	rolling
Total pools (%)	50
Pattern	irregular
Confinement	frequently confined
Unstable banks (%)	20
Substrate composition (%)	
fines (<2 mm)	10
gravels (2-64 mm)	25
larges (>64 mm)	60
bedrock and/or oil sand	5
Debris	low

### REACH DESCRIPTION AND FISH UTILIZATION

This section is a short, irregularly meandering reach. River banks are up to 40 m high and unstable areas are common. Water velocities and gradient are moderately high. Flow character throughout the reach is almost entirely rolling, and pools comprise about half of the total reach area. Larges (rubble and boulders) and gravels are dominant substrates. Deciduous trees form the dominant component of the riparian vegetation, and coniferous trees, deciduous shrubs and grasses are all present in smaller amounts. Some vegetation overhangs the river.

The potential of this reach for spawning is considered to be good or excellent for most fish that occur in the river, because it contains a diversity of substrate sizes, current velocities and water depths. Unidentified fish eggs, collected in late May, provided proof of spawning in the reach. Adults of arctic grayling and longnose sucker, both spring spawners, were captured in May. The combination of occasional grassy shallow backwaters, areas shaded by overhanging vegetation, and substrate composed of gravels and larges provides good rearing areas for most fish species in the river. Large numbers of young lake chub, white sucker and longnose sucker were captured in this reach. Most young forage fish prefer the quiet sheltered areas, whereas young arctic grayling prefer rocky substrates. The areas of overhanging riparian vegetation and the numerous pools provide good resting and feeding areas for larger fish. The high numbers of forage fish, particularly lake chub, provide a good food source for piscivorous fishes. Although there are many pools in this reach, the relatively shallow water depths may preclude overwintering of fish.

# BENTHIC INVERTEBRATES

GASTROPODA PELECYPODA Musculium

INSECTA

Ephemeroptera Baetis Rhithrogena Stenonema

Odonata Ophiogomphus

Plecoptera Isoperla Trichoptera Cheumatopsyche Glossosoma

Hydropsyche Diptera Chironomidae Chironominae

Tanypodinae Orthocladiinae Rhagionidae Atherix

### RIPARIAN VEGETATION

Bank coverage (%) Coniferous trees 20 40 Deciduous trees Shrubs 20 Grasses 20 Channel cover (%) Overhang Crown

### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

### STREAM GAUGING DATA

No data available for this reach

### WATER QUALITY

No data available for this reach



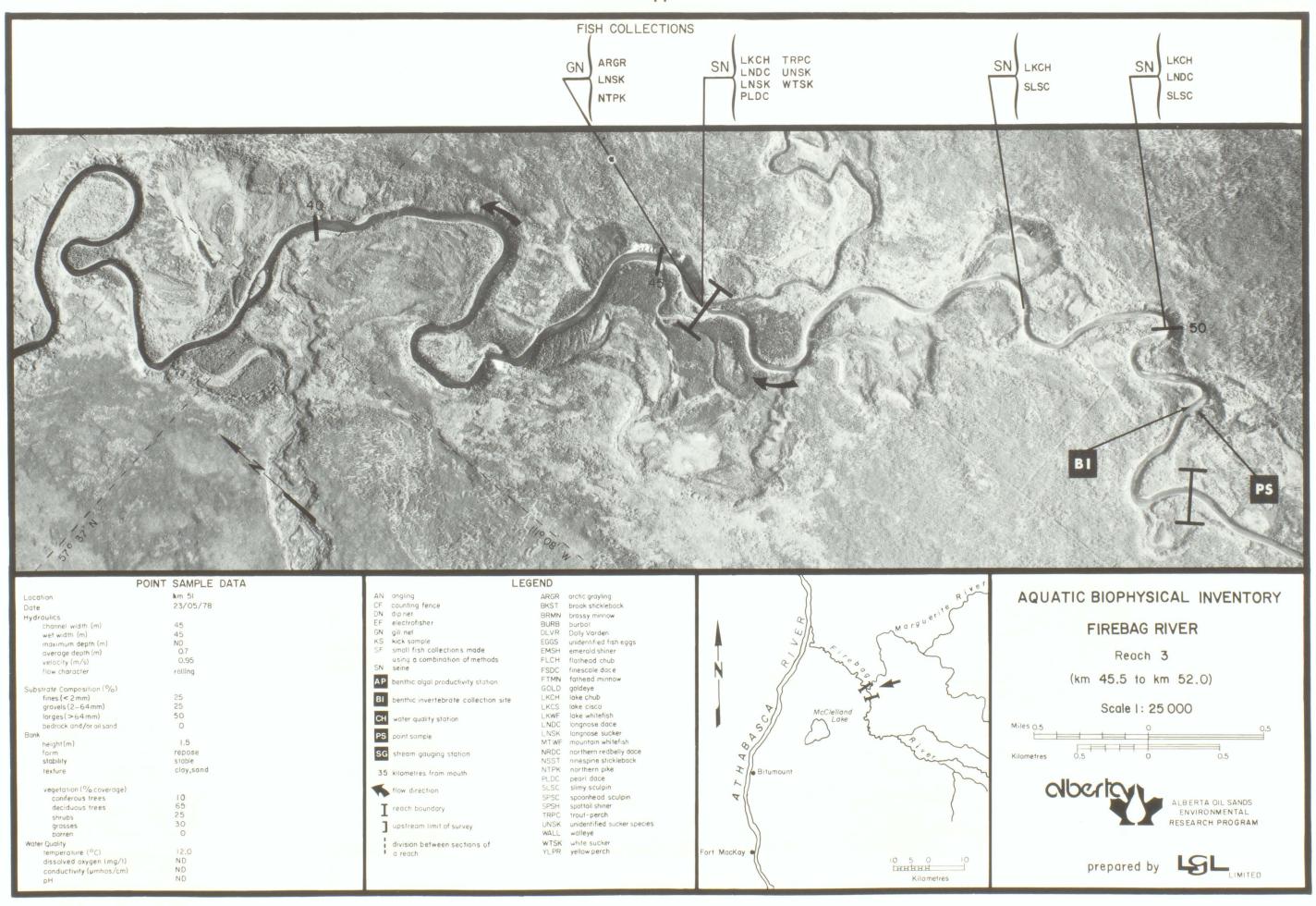
A placid section at km 51.5 near the upper boundary of reach 3.

# AQUATIC BIOPHYSICAL INVENTORY FIREBAG RIVER

Reach 3 (km 45.5 to km 52.0)







	Adults		Juveniles and Young-of-the-year		Total Numbers	
Species	May	September	May	September	May	September
arctic grayling	3	0	3	0	6	0
lake chub	0	0	0	132	0	132
longnose dace	0	0	0	50	0	50
longnose sucker	2	0	1	23	3	23
ninespine stickleback	0	0	0	2	0	2
northern pike	0	4	0	0	0	4
pearl dace	0	0	0	10	0	10
slimy sculpin	0	0	2	3	2	3
trout-perch	0	0	0	3	0	3
unidentified suckers	0	0	0	5	0	5
walleye	1	2	1	0	2	2
white sucker	0	5	2	14	2	19
Total	6	11	9	242	15	253

### PHYSICAL CHARACTERISTICS

P	Reach length (km)	23	.0
C	Channel width (m)	55	
C	Channel area (ha)	126	. 5
G	Gradient (m/km)	1	. 0
F	low character	swir	ling
7	fotal pools (%)	85	
F	Pattern	irregularly	meandering
(	Confinement	frequently	confined
l	Unstable banks (%)	40	
5	Substrate composition (%)		
	fines (<2 mm)	15	
	gravels (2-64 mm)	35	
	larges (>64 mm)	40	
	bedrock and/or oil sand	10	
	Debris	mode	rate

### REACH DESCRIPTION AND FISH UTILIZATION

Due to river erosion of sand-clay and sand-bitumen cut banks, many of the river banks in this irregularly meandering reach are unstable. Water velocities and gradient are moderate. A high proportion of the reach is composed of pools, and the flow character is swirling throughout almost the entire reach. Larges (rubble and boulders) and gravels are dominant substrates. Deciduous trees dominate riparian vegetation, and grasses and deciduous shrubs overhang the channel. More debris is found in this reach than in any other surveyed in the Firebag

Because of the diversity of substrate sizes, current velocities and water depths, the spawning potential of this reach for most fish that are found in the river is considered to be good to excellent. Unidentified fish eggs were collected in gravelly shallows in late May and all adults captured in this reach in the spring were spent. Adult spring spawners captured here in the spring include arctic grayling, longnose sucker and walleye. Rearing potential for most young fish is considered to be good because of the presence of areas sheltered by overhanging vegetation, rocky substrates and moderate quantities of debris. Young lake chub and longnose dace were particularly numerous in this reach. The high number of pools and areas shaded by overhanging vegetation provide good feeding and resting areas for larger fish. Sheltered backwaters inhabited by forage fish, particularly lake chub, provide good feeding areas for walleye and northern pike. Although pools compose a high percentage of the total reach area, water depths are shallow and fish overwintering is probably limited to isolated deep pools.

### BENTHIC INVERTEBRATES NEMATODA

PELECYPODA Sphaerium INSECTA Ephemeroptera Baetis Ephemerella Rhithrogena

Odonata Ophiogomphus Plecoptera Diura Isoperla

Pteronarcys Trichoptera Brachycentrus Cheumatopsyche Hydropsyche Levidostoma Coleoptera Elmidae

Diptera Tipulidae Chironomidae Chironominae Tanypodinae Simuliidae Rhagionidae Atherix Empididae

### RIPARIAN VEGETATION

Crown

Bank coverage (%) Coniferous trees 10 Deciduous trees Shrubs Grasses Barren Channel cover (%) Overhang

### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

### STREAM GAUGING DATA

No data available for this reach

### WATER QUALITY

No data available for this reach



Swirling flow character at km 60.5 is representative of reach 4.



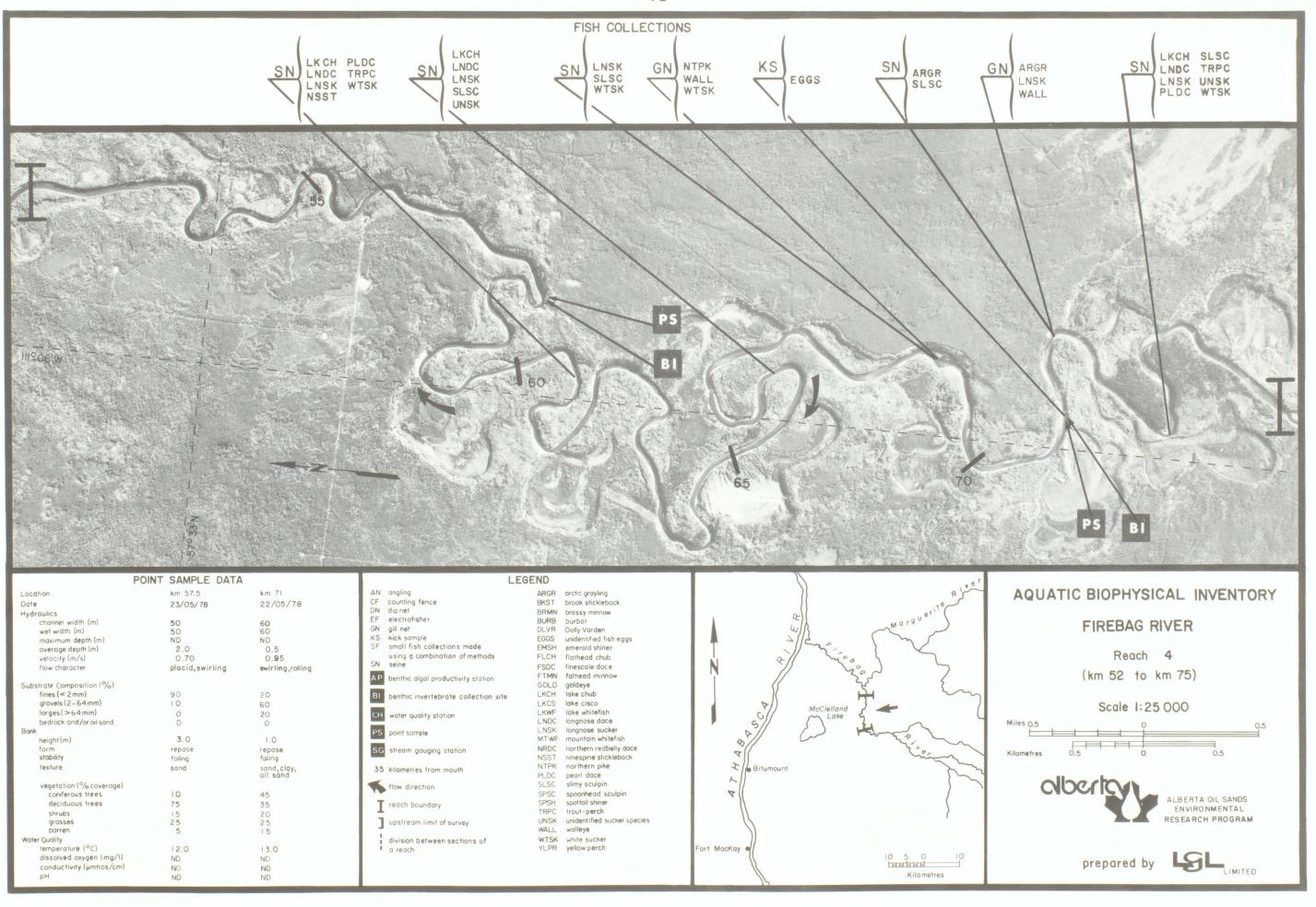
Sand and clay bank at km 71.5.

# AQUATIC BIOPHYSICAL INVENTORY FIREBAG RIVER

Reach 4 (km 52 to km 75)







Species	Adults		Juveniles and Young-of-the-year		Total Numbers	
	May	September	May	September	May	September
arctic grayling	0	3	0	35	0	38
flathead chub	0	0	0	1	0	1
lake chub	0	0	0	12	0	12
longnose dace	0	0	0	<u> 4</u>	0	4
longnose sucker	0	0	0	2	0	2
northern pike	0	<i>L</i> <sub>4</sub>	0	1	0	5
trout-perch	0	0	0	2	0	2
unidentified suckers	0	0	0	10	0	10
white sucker	0	1	3	1	3	2
Total	0	8	3	68	3	76

### PHYSICAL CHARACTERISTICS

Reach length (km)	21.0
Channel width (m)	50
Channel area (ha)	105.0
Gradient (m/km)	1.7
Flow character	swirling, roll <b>ing</b> broken
Total pools (%)	25
Pattern	irregularly meandering
Confinement	frequently confined
Unstable banks (%)	30
Substrate composition (%)	
fines (<2 mm)	10
gravels (2-64 mm)	40
larges (>64 mm)	50
bedrock and/or oil sand	0
Debris	low

### REACH DESCRIPTION AND FISH UTILIZATION

This reach is essentially a riffle area. Only a relatively small proportion of the reach area is composed of pools, and waters are generally shallow. Areas of unstable river banks are numerous in this irregularly meandering reach. Moderate water velocities and gradient prevail in this reach and the flow character varies from swirling to rolling to broken. The substrate consists primarily of larges and gravels. Riparian vegetation is mostly deciduous trees, grasses and deciduous shrubs, some of which overhang the banks.

The diversity of water velocities, water depths and substrate sizes provide good spawning areas which are suitable for most fish species that are found in the Firebag River. Fine substrates are suitable for spawning of trout-perch and pearl dace and also possibly for spawning of lake whitefish. Grassy shallows in areas with fine substrates are suitable for northern pike spawning. All other species found in the river (including arctic grayling) may spawn over the substrates composed of gravels and larges. Unidentified fish eggs were collected from an area with rubble and gravel substrates in this reach. Areas sheltered by overhanging riparian vegetation, grassy shallows and sheltered backwaters provide good rearing areas for the young of most fish species in the river, and the abundance of gravel and rubble substrates is excellent for young arctic grayling. Relatively high numbers of young arctic grayling were captured in this reach. Backwaters sheltered by overhanging vegetation are suitable areas for most larger fish to rest and feed. The predominating riffle areas provide good feeding habitat for arctic grayling. Overwintering potential is limited to the few deep pools in the reach.

### BENTHIC INVERTEBRATES OLIGOCHAETA

GASTROPODA PELECYPODA

Sphaerium INSECTA

Ephemeroptera

Stenonema Plecoptera Claassenia

Diura Isoperla Pteronarcys

Trichoptera Cheumatopsyche Glossosoma Hydropsyche

Lepidostoma Coleoptera Elmidae Diptera Chironomidae Chironominae Tanypodinae Simuliidae Tabanidae Rhagionidae

Atherix Empididae

### RIPARIAN VEGETATION

Bank coverage (%) Coniferous trees 10 55 Deciduous trees Shrubs Grasses Barren 20 Channel cover (%) Overhang

### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

### STREAM GAUGING DATA

No data available for this reach

### WATER QUALITY

No data available for this reach



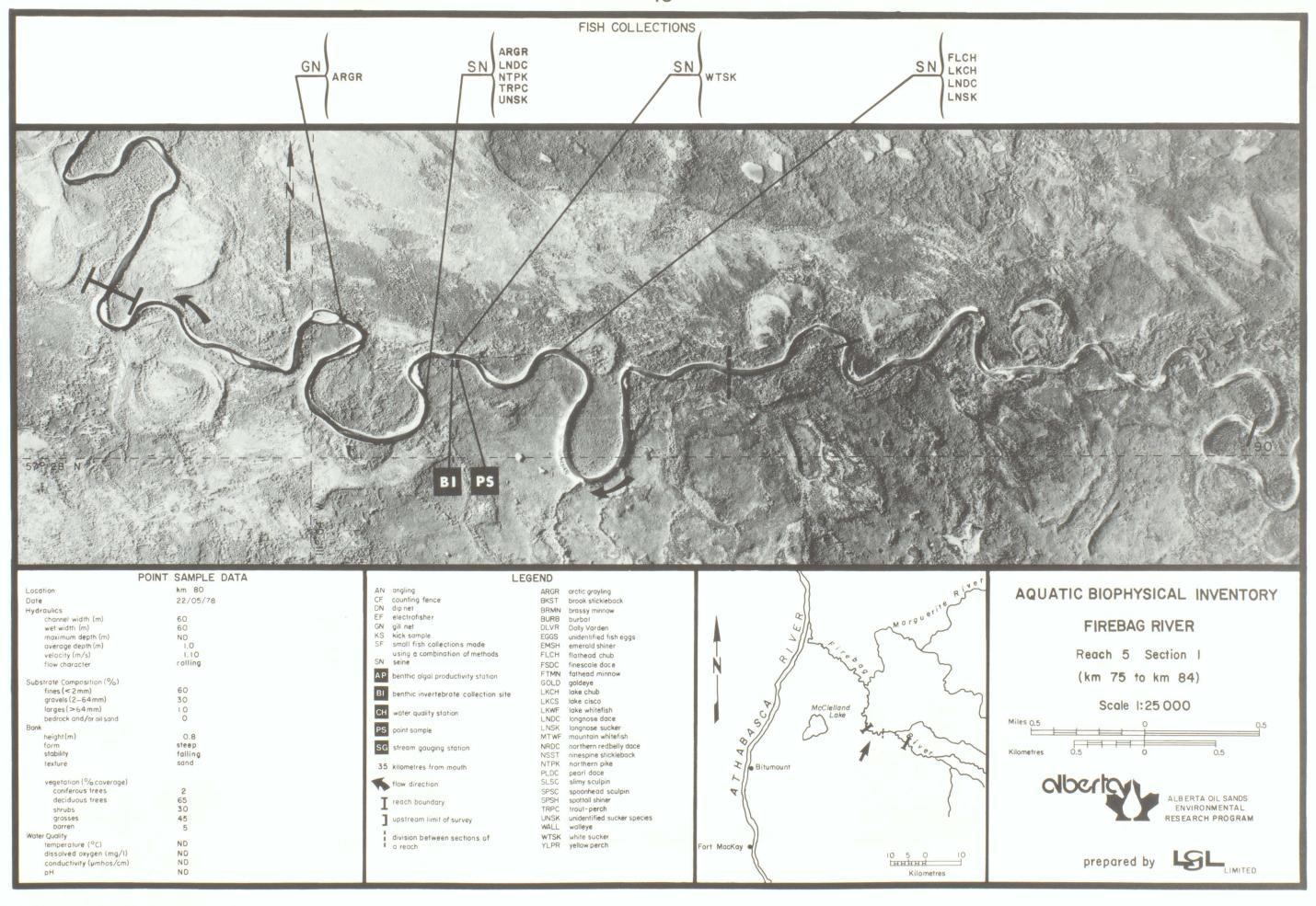
Riffle section of reach 5 at km 80.

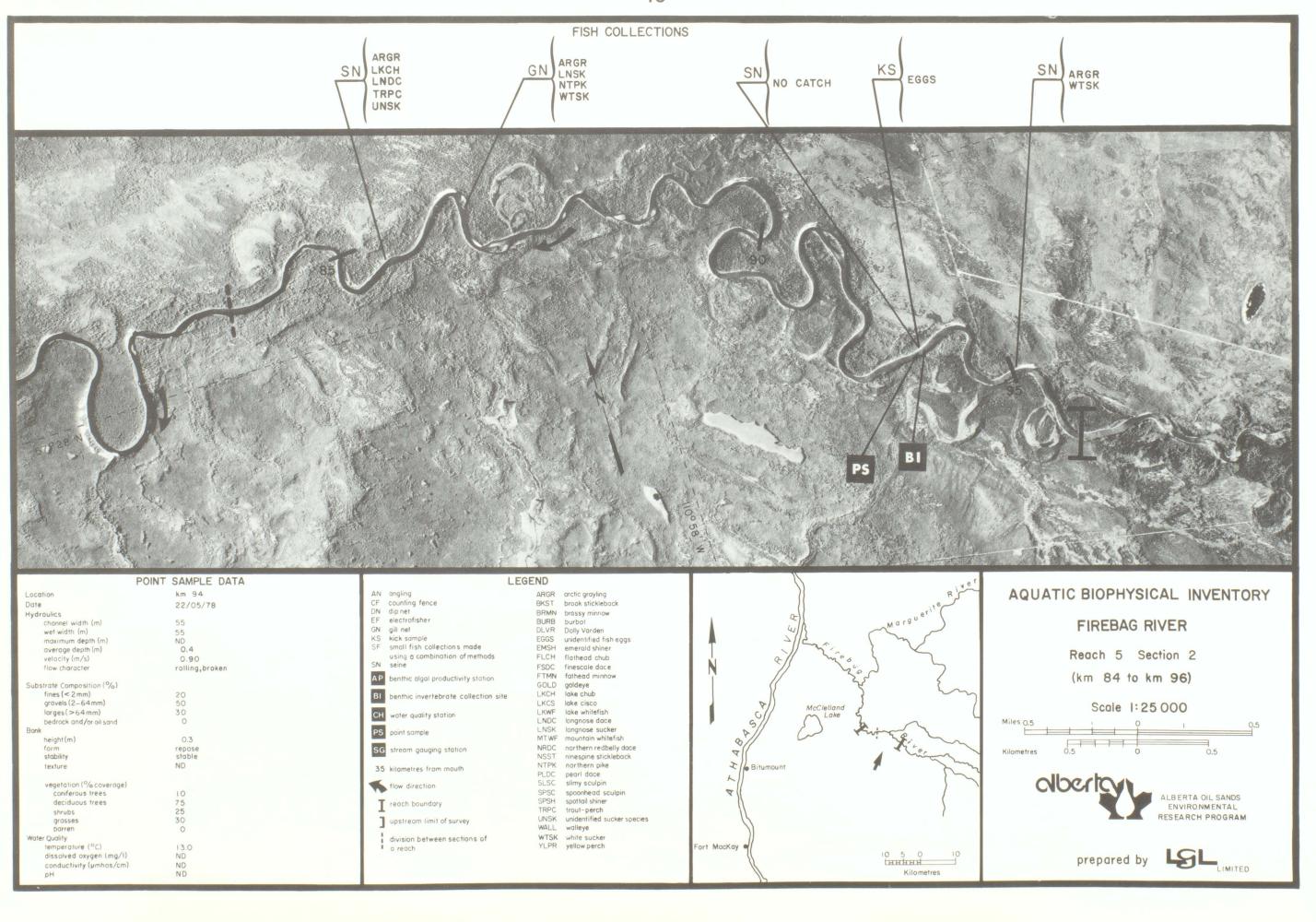
# AQUATIC BIOPHYSICAL INVENTORY FIREBAG RIVER

Reach 5 (km 75 to km 96)









	Adults		Juveniles and Young-of-the-year		Total Numbers	
Species	May	September	May	September	May	Septembe
arctic grayling	1	1	3	47	4	48
lake chub	0	0	0	1	0	1
longnose dace	0	0	1	5	1	5
longnose sucker	0	1	1	0	1	1
ninespine stickleback	0	0	0	2	0	2
northern pike	5	7	0	12	5	19
slimy sculpin	0	0	2	5	2	5
trout-perch	0	0	0	1	0	1
unidentified suckers	0	0	0	31	0	31
walleye	2	0	0	0	2	0
white sucker	0	8	0	1	0	9
Total	8	17	7	105	15	122

### PHYSICAL CHARACTERISTICS

Reach length (km)	27.0
Channel width (m)	30
Channel area (ha)	81.0
Gradient (m/km)	3.3
Flow character	rolling, broken
Total pools (%)	30
Pattern	irregularly meandering
Confinement	unconfined
Unstable banks (%)	5
Substrate composition (%)	
fines (<2 mm)	10
gravels (2-64 mm)	30
larges (>64 mm)	60
bedrock and/or oil sand	0
Debris	low

### REACH DESCRIPTION AND FISH UTILIZATION

This section, the most upstream reach of the portion of the Firebag River that was surveyed, meanders irregularly and is primarily an extensive riffle zone with the occasional moving pool. The river banks are generally stable. This reach has the steepest gradient and highest water velocities encountered in the surveyed portion of the Firebag River. Waters are shallow and the flow character is rolling and broken. A relatively small proportion of the reach is pools. As in Reach 5, gravels and larges are the dominant components of the substrate material. Deciduous shrubs dominate riparian vegetation and overhang the channel in some areas.

The potential of this reach for spawning of both sport and forage fish is considered to be excellent. Numerous grassy side sloughs provide good spawning areas for northern pike and some forage fish. The many areas with rocky substrates are excellent spawning areas for arctic grayling and some species of forage fish. Walleye in the reach may spawn in a variety of areas. (Adult arctic grayling, northern pike and walleye were captured in the spring in this reach.) Rearing potential for sport fish is considered to be excellent; many young-of-the-year arctic grayling were captured in shallow gravel riffles, and young-of-the-year northern pike were captured in weedy areas with sandy substrates. The gravelly riffle areas should provide excellent feeding areas for arctic grayling, and northern pike and walleye can feed in the more placid backeddies and side sloughs. Fish probably overwinter only in the deeper backwaters of the reach.

### BENTHIC INVERTEBRATES

GASTROPODA Ferrissia PELECYPODA Musculium INSECTA Ephemeroptera Trichoptera Ceraclea Cheumatopsyche Glossosoma Polycentropus Coleoptera Elmidae Diptera

Tipulidae Chironomidae Chironominae Tanypodinae Orthocladiinae

### RIPARIAN VEGETATION

Bank coverage (%) 25 15 Coniferous trees Deciduous trees Shrubs Grasses Barren Channel cover (%) Overhang Crown

### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

### STREAM GAUGING DATA

No data available for this reach

### WATER QUALITY

No data available for this reach

Unstable sand and clay bank at km 109.5.

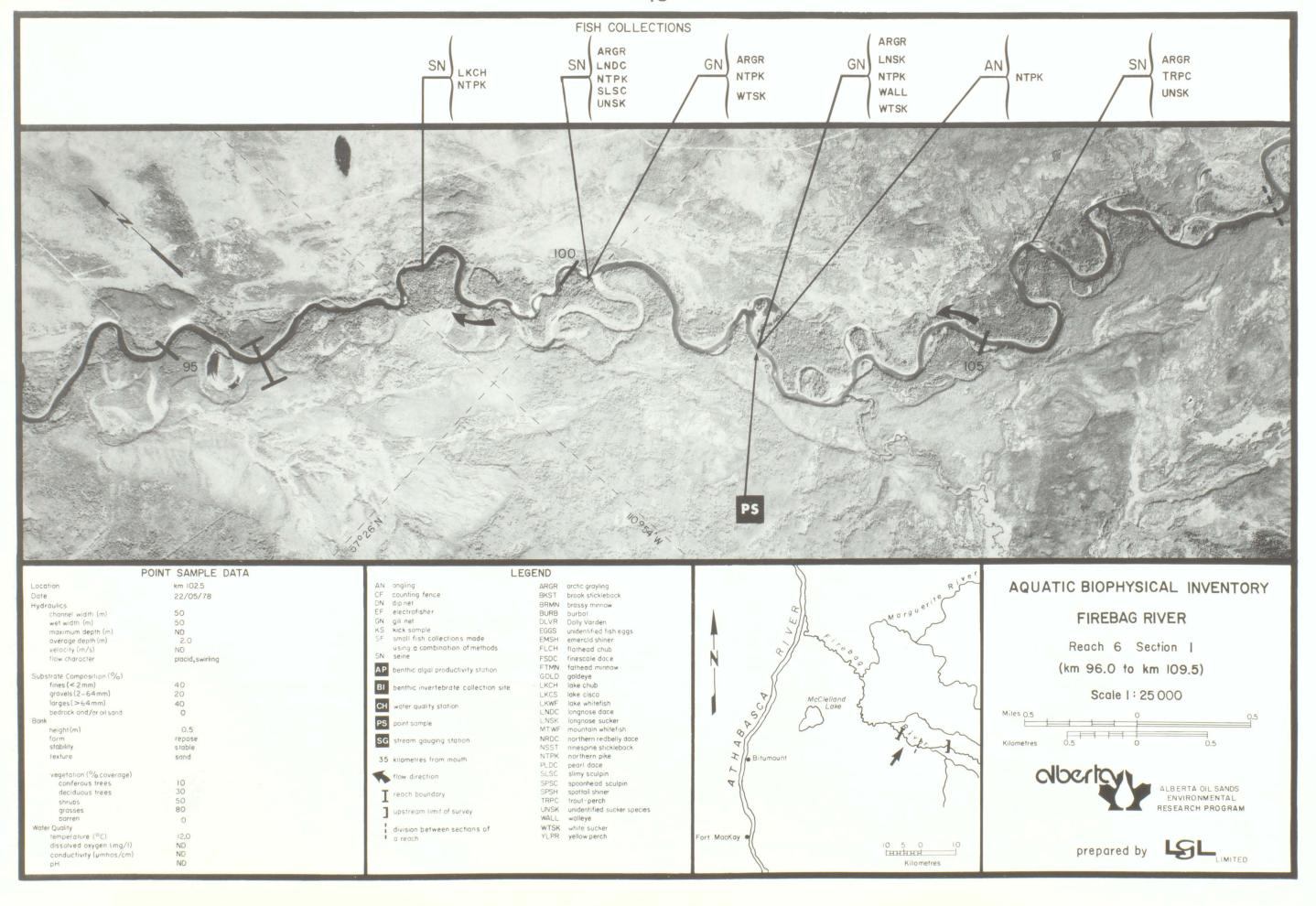
Extensive riffle section at km 120 is typical of reach 6.

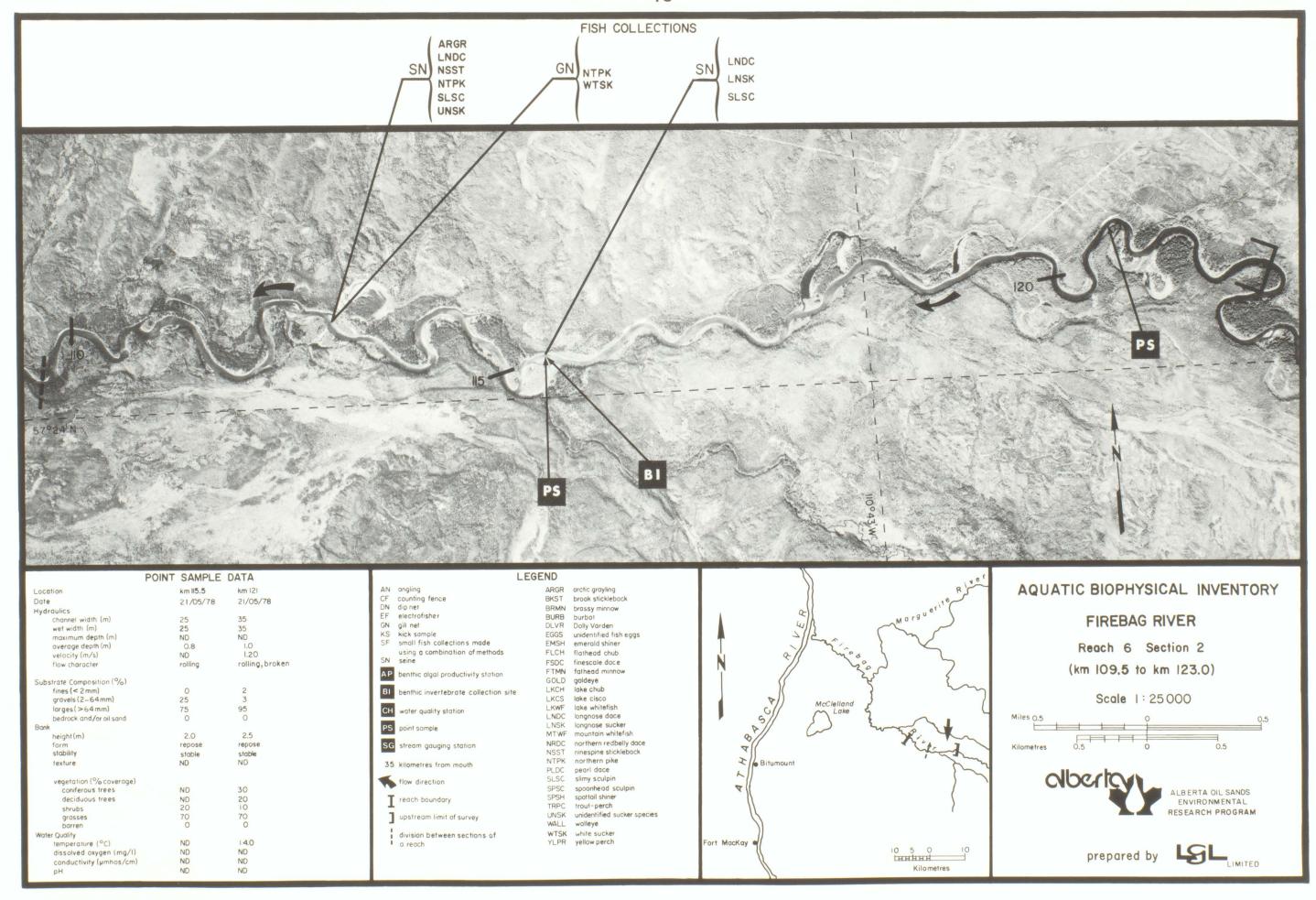
# AQUATIC BIOPHYSICAL INVENTORY FIREBAG RIVER

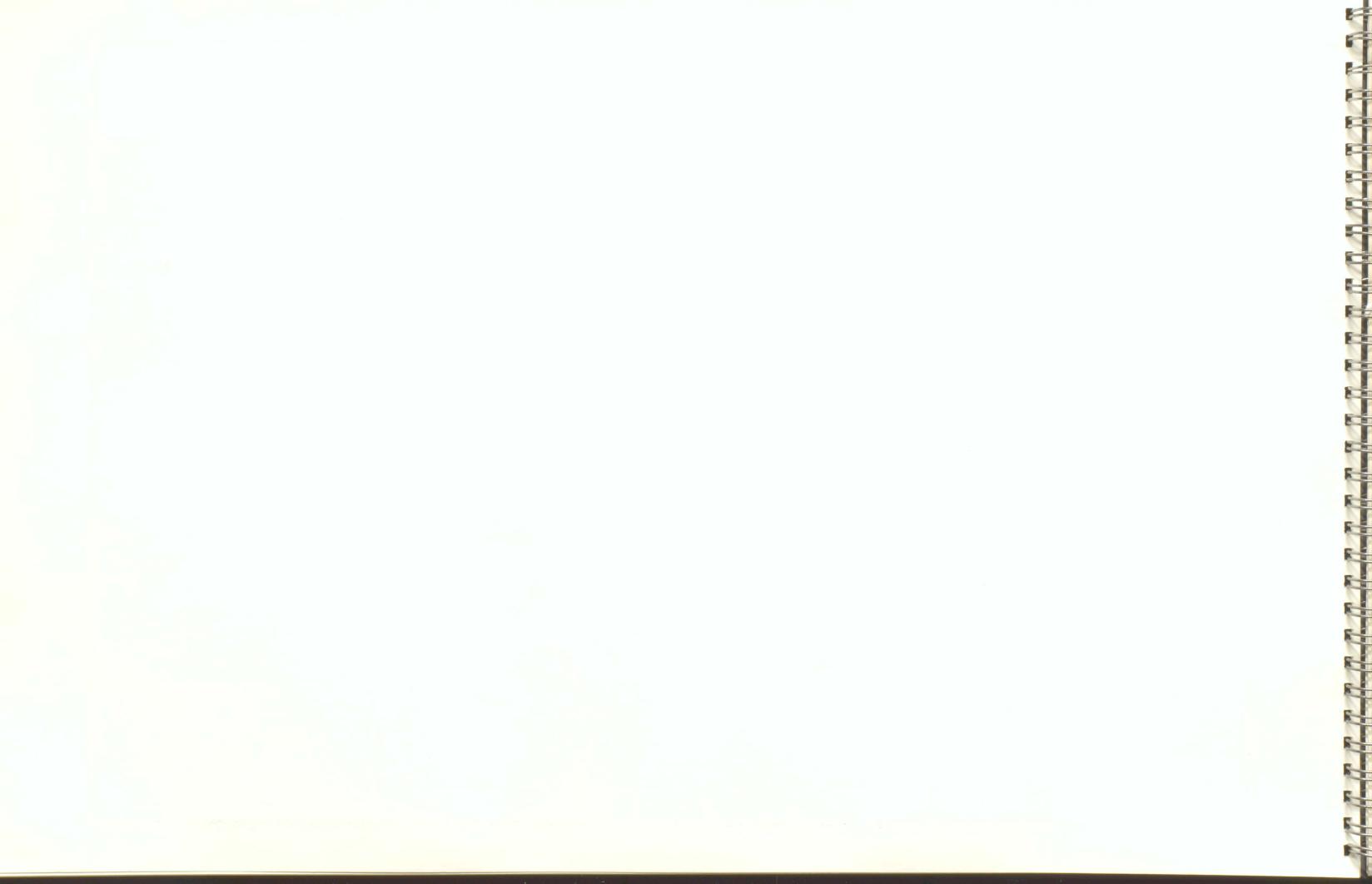
Reach 6 (km 96 to km 123)



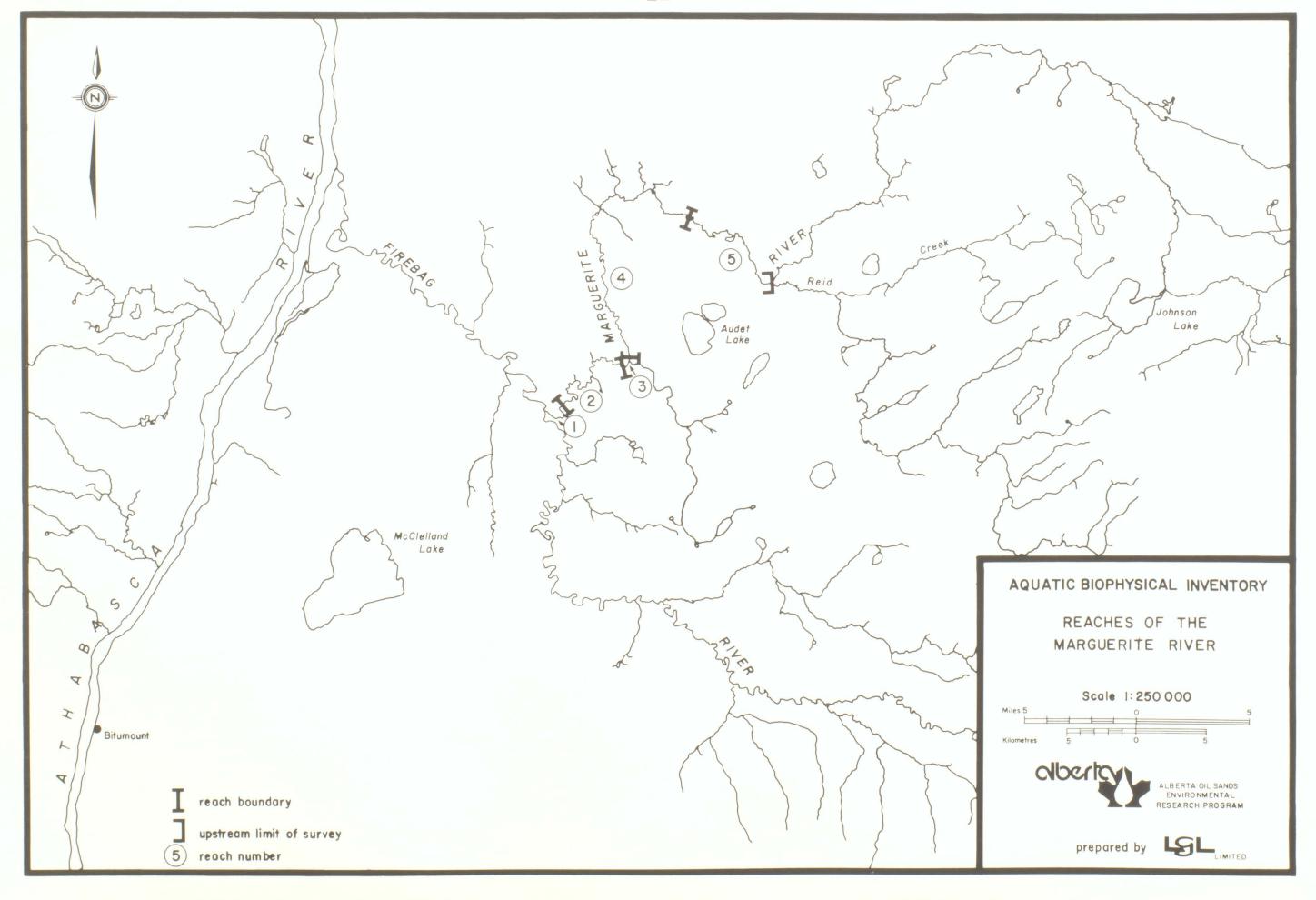








MARGUERITE RIVER



Species	Adults		Juveniles and Young-of-the-year		Total numbers	
	May	September	May	September	May	September
arctic grayling	1	1	1	0	2	1
lake chub	0	0	0	8	0	8
longnose dace	0	0	0	13	0	13
longnose sucker	5	1	0	10	5	11
northern pike	0	2	0	0	0	2
slimy sculpin	0	0	0	1	0	1
trout-perch	0	1	0	7	0	8
unidentified suckers	0	0	0	3	0	3
white sucker	0	0	0	8	0	8
Total	6	5	1	50	7	55

### PHYSICAL CHARACTERISTICS

Reach length (km)	3.0
Channel width (m)	40
Channel area (ha)	12.0
Gradient (m/km)	1.4
Flow character	broken, tumbling
Total pools (%)	10
Pattern	irregular
Confinement	frequently confined
Unstable banks (%)	10
Substrate composition (%)	
fines (<2 mm)	10
gravels (2-64 mm)	25
larges (>64 mm)	45
bedrock and/or oil sand	20
Debris	moderate

### REACH DESCRIPTION AND FISH UTILIZATION

A relatively short reach, this section flows in an irregular pattern and the river banks are relatively stable. Water velocities are the highest and gradient is the second highest recorded in the surveyed portion of the river. A low proportion of the total reach area is composed of pools. The flow character is primarily broken and tumbling, with occasional white-water rapids where the river flows over limestone ledges. Substrate composition is varied, with gravels and larges predominating. Deciduous trees and grasses dominate the riparian vegetation and there is a moderate amount of vegetation overhanging the channel.

The diversity of substrate types in this reach provides spawning areas which are probably suitable for many of the fish species found in the Marquerite River. Arctic grayling, mountain whitefish, suckers, and some of the minnows may spawn over the rocky substrates, and the remaining species may spawn over either the rocky or the sandy substrates. Adult arctic grayling and longnose suckers, both spring spawners, were captured here in the spring. The rocky substrates, moderate quantities of debris, and overhanging vegetation provide some rearing areas for several fish species. Young individuals of seven species were captured in this reach. Because of the relatively high water velocities and low number of pools, the resting and feeding potential for larger fish is considered to be low, although some larger fish may inhabit areas near the banks which are shaded by overhanging vegetation. Shallow water depths and the low number of pools preclude significant overwintering of fish in the reach.

### BENTHIC INVERTEBRATES

GASTROPODA Stagnicola PELECYPODA

Musculium Sphaerium

INSECTA

Ephemeroptera Baetis Drunella Ephemera Paraleptophlebia Stenonema

Plecoptera Pteronarcys Trichoptera

Tanypodinae Rhagionidae Atherix Empididae

Cheumatopsyche Glossosoma Lepidostoma Diptera Chironomidae

### RIPARIAN VEGETATION

Crown

Bank coverage (%) 20 40 Coniferous trees Deciduous trees Shrubs 20 Grasses Barren Channel cover (%) Overhang

Marguerite River at km 0.5.

### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

### STREAM GAUGING DATA

No data available for this reach

### WATER QUALITY

No data available for this reach

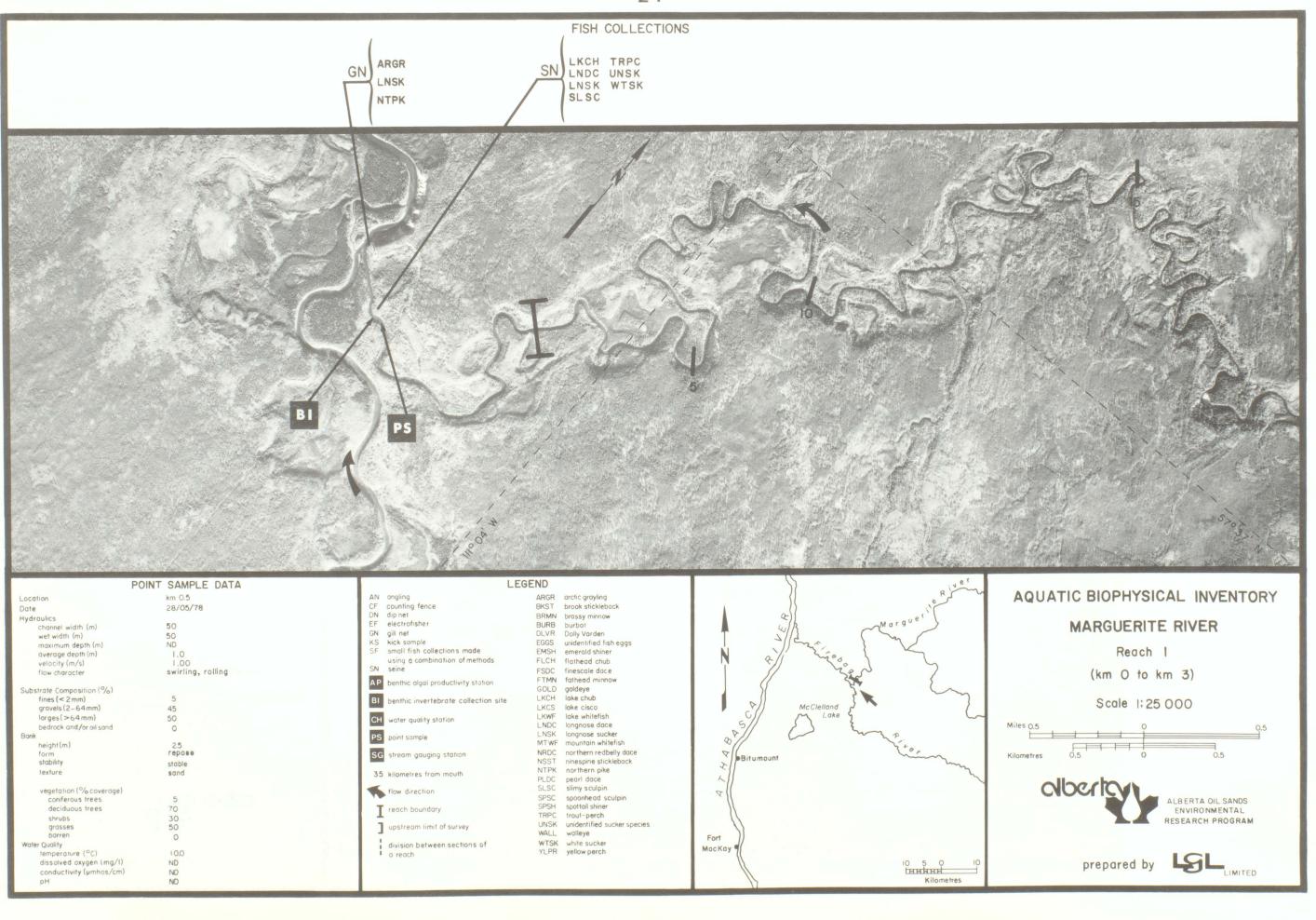


# AQUATIC BIOPHYSICAL INVENTORY MARGUERITE RIVER

Reach I (km O to km 3)







	Adults		Juveniles and Young-of-the-year		Total Numbers	
Species	May	September	May	September	May	September
arctic grayling	0	0	3	0	3	0
brook stickleback	0	0	0	1 = =	0	1
lake chub	0	0	1	44	1	44
longnose dace	0	0	0	9	0	9
longnose sucker	0	0	2	14	2	14
slimy sculpin	0	0	0	4	0	$L_{\frac{1}{4}}$
spoonhead sculpin	0	0	2	0	2	0
trout-perch	0	0	0	3	0	3
unidentified suckers	0	0	0	7	0	7
white sucker	0	0	3	8	3	8
Total	0	0	11	90	11	90

### PHYSICAL CHARACTERISTICS

Reach length (km)	15.5
Channel width (m)	30
Channel area (ha)	46.5
Gradient (m/km)	0.8
Flow character	placid, swirling
Total pools (%)	90
Pattern	tortuously meandering
Confinement	confined
Unstable banks (%)	25
Substrate composition (%)	
fines (<2 mm)	70
gravels (2-64 mm)	30
larges (>64 mm)	0
bedrock and/or oil sand	0
Debris	1 ow

### REACH DESCRIPTION AND FISH UTILIZATION

This section is tortuously meandering and is essentially a long continuously swirling or placid pool. Gradient and water velocities are moderate. The substrate is mostly fines with some gravels. Coniferous and deciduous trees and deciduous shrubs are all important components of the riparian vegetation, and grasses are abundant. A moderate amount of vegetation overhangs the channel.

The predominating sandy substrates provide areas suitable for spawning of a few of the forage fish (e.g., trout-perch, pearl dace) found in the reach. Areas with gravelly substrates which may be suitable for spawning of the other species found in the river are limited. No adults were captured in this reach during the study. Rearing potential is considered to be poor to moderate; the moderate amount of overhanging vegetation and the small amount of debris provide the only suitable areas. Young lake chub were the most abundant fish collected. Moderate numbers of small forage fish and young of larger species captured in the reach provide a food source for piscivores, such as northern pike. Resting and feeding potential for larger fish is considered to be good to excellent because of the many pools in the reach. Overwintering potential is considered to be . excellent because of the generally deep waters and large number of pools.

### BENTHIC INVERTEBRATES PELECYPODA Musculium INSECTA Hemiptera Corixidae Diptera Tipulidae Chironomidae Chironominae Tanypodinae Orthocladiinae

Bank coverage (%)	
Coniferous trees	25
Deciduous trees	25
Shrubs	25
Grasses	60
Barren	(
Channel cover (%)	
Overhang	-
Crown	(

### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

### STREAM GAUGING DATA

No data available for this reach

### WATER QUALITY

No data available for this reach



Overhanging vegetation at km 5.

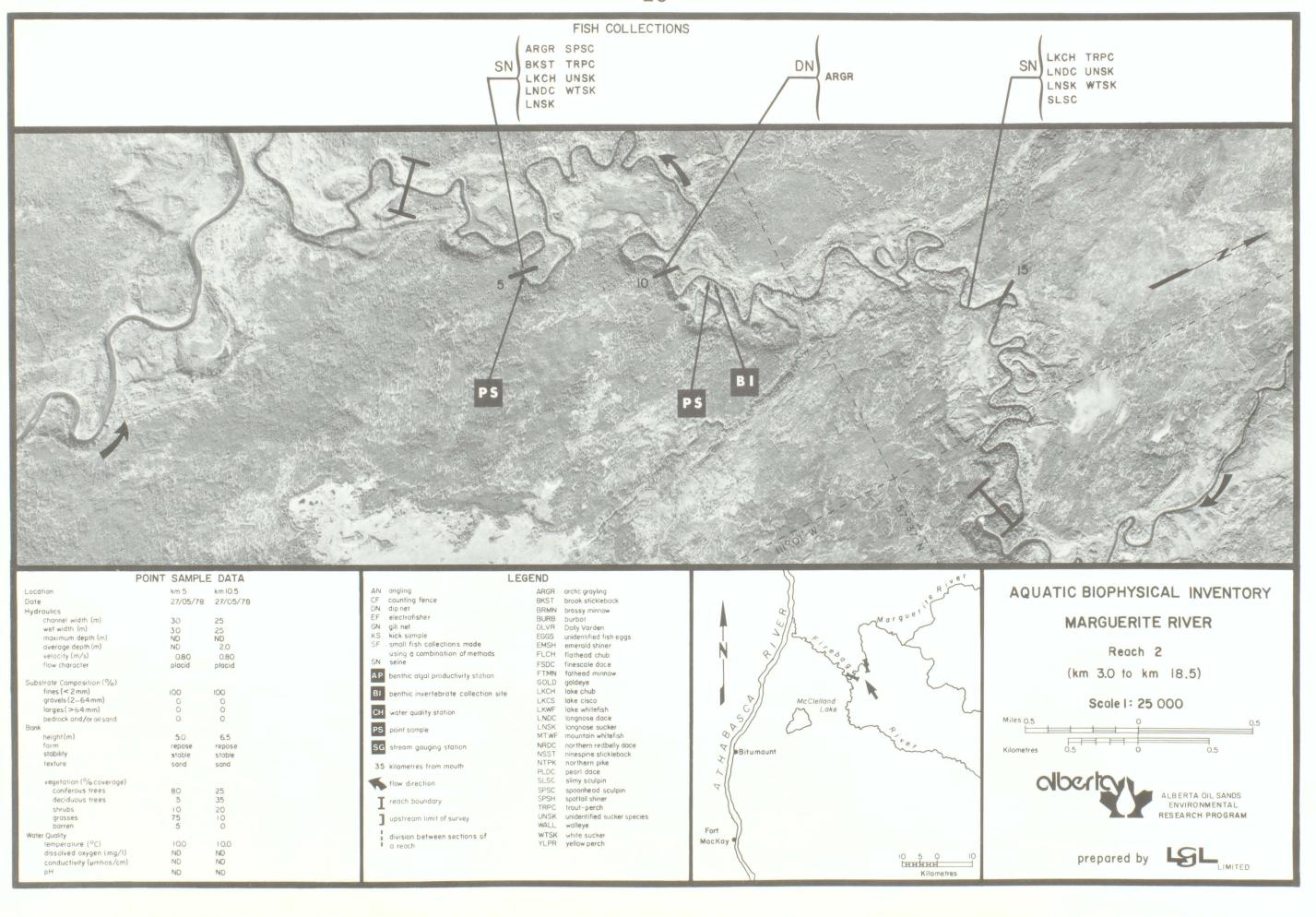
Placid pool, typical of reach 2, at km 10.5.

## AQUATIC BIOPHYSICAL INVENTORY MARGUERITE RIVER

Reach 2 (km 3.0 to km 18.5)







Species	Adults		Juveniles and Young-of-the-year		Total Numbers	
	May	September	May	September	May	September
arctic grayling	0	0	5	4	5	4
lake chub	0	0	0	3	0	3
longnose dace	0	0	1	2	1	2
longnose sucker	0	0	0	7	0	7
mountain whitefish	0	0	0	6	0	6
northern pike	0	2	0	0	0	2
slimy sculpin	0	1	13	47	13	48
trout-perch	0	0	1	0	1	0
unidentified suckers	0	0	0	1	0	1
white sucker	0	0	4	4	4	4
Total	0	3	24	74	24	77

### PHYSICAL CHARACTERISTICS

Reach length (km)	1.5
Channel width (m)	25
Channel area (ha)	3.8
Gradient (m/km)	3.0
Flow character	broken, tumbling
Total pools (%)	10
Pattern	irregularly meandering
Confinement	confined
Unstable banks (%)	25
Substrate composition (%)	
fines (<2 mm)	30
gravels (2-64 mm)	15
larges (>64 mm)	40
bedrock and/or oil sand	15
Debris	moderate

### REACH DESCRIPTION AND FISH UTILIZATION

This reach is a short section which is almost entirely riffles. Gradient is the highest and water velocities the second highest in the surveyed portion of the Marguerite River. Substrate types are varied, with larges and fines being the most abundant. Coniferous and deciduous trees, deciduous shrubs, and grasses are all important components of the riparian vegetation and a fairly high proportion of the channel is covered by overhanging shrubs.

Because the reach contains a diversity of substrate sizes, current velocities, and water depths, spawning potential is considered to be good to excellent. The collection of unidentified fish eggs in late May provided proof of spawning in the reach. Rearing potential is considered to be good because of the rocky substrates, moderate quantities of debris, and the relative abundance of overhanging vegetation. Young of eight fish species were captured in this reach and slimy sculpin were especially abundant. Resting and feeding potential for larger fish is considered to be poor to moderate; the major suitable areas being those under overhanging vegetation. Relatively high water velocities and the low number of pools limit the resting and feeding potential for larger fish. Shallow water depths and the low number of pools probably preclude overwintering of fish.

# BENTHIC INVERTEBRATES

HIRUDINEA INSECTA Ephemeroptera

Odonata Hemiptera Corixidae Trichoptera

Coleoptera Elmidae Diptera Tipulidae Psychodidae Chironomidae Chironominae Tanypodinae Orthocladiinae Simuliidae Rhagionidae Empididae

### RIPARIAN VEGETATION

Bank coverage (%) Coniferous trees 25 25 25 Deciduous trees Shrubs Grasses 25 Barren Channel cover (%) Overhang Crown

### BENTHIC ALGAL PRODUCTIVITY

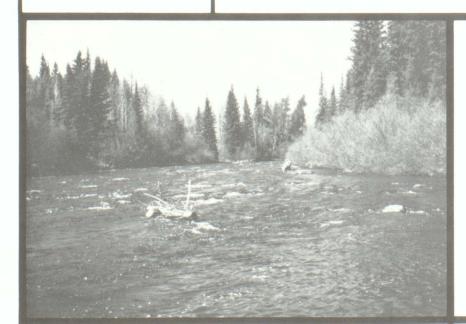
No data available for this reach

### STREAM GAUGING DATA

No data available for this reach

### WATER QUALITY

No data available for this reach



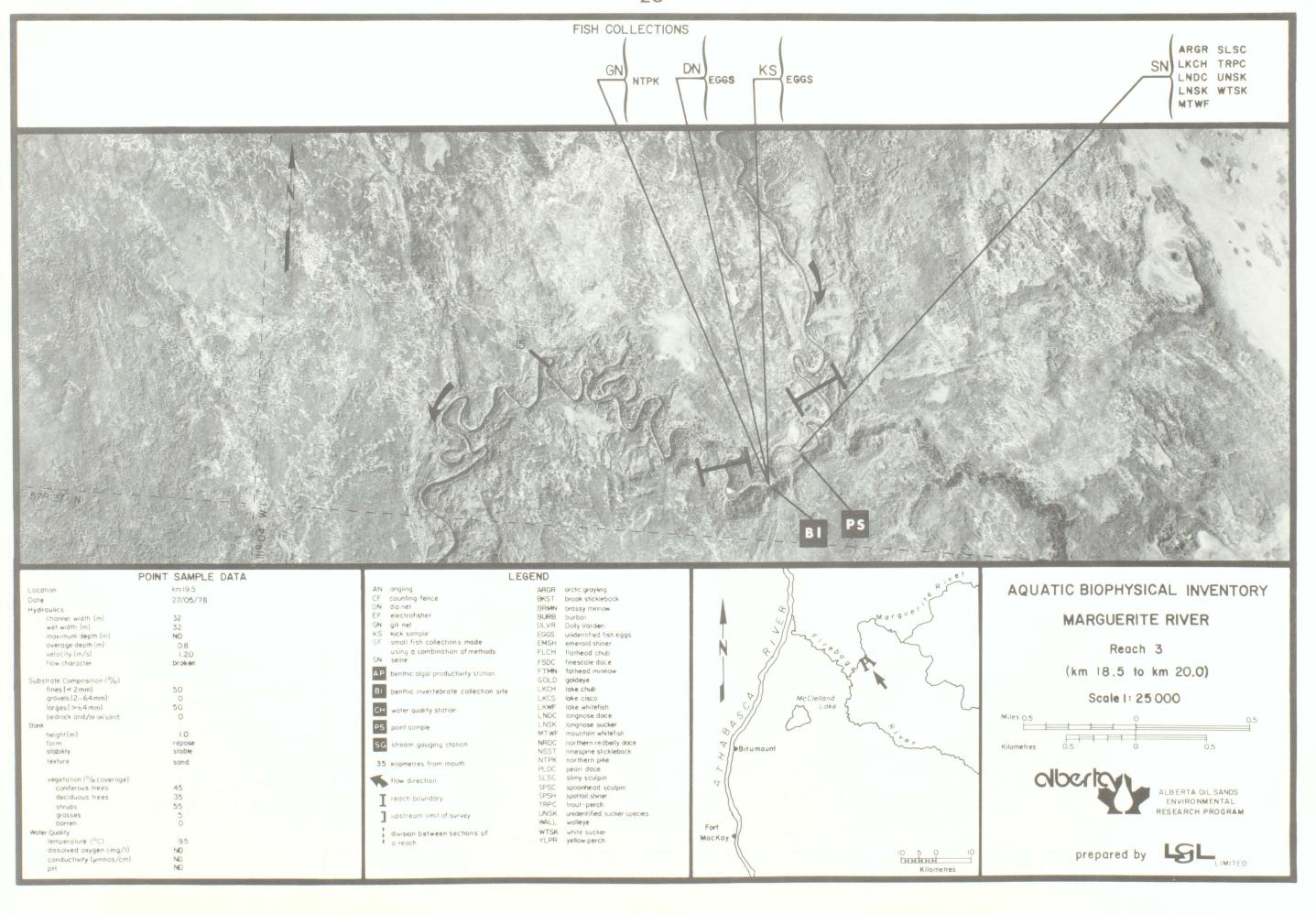
Large riffle area at km 19.5.

# AQUATIC BIOPHYSICAL INVENTORY MARGUERITE RIVER

Reach 3 (km 18.5 to km 20.0)







Species	Adults		Juveniles and Young-of-the-year		Total Numbers	
	May	September	May	September	May	Septembe
arctic grayling	0	1	4	0	4	1
brook stickleback	0	0	0	2	0	2
lake chub	0	0	0	244	0	244
longnose dace	0	0	0	1	0	1
longnose sucker	0	0	1	15	1	15
northern pike	0	2	0	0	0	2
pearl dace	0	0	0	L <sub>4</sub>	0	4
slimy sculpin	0	1	0	17	0	18
spoonhead sculpin	0	0	1	1	1	1
trout-perch	0	0	0	22	0	22
unidentified suckers	0	0	0	8	0	8
white sucker	0	2	0	34	0	36
Total	0	6	6	348	6	354

### PHYSICAL CHARACTERISTICS

Reach length (km)	41.0
Channel width (m)	25
Channel area (ha)	102.5
Gradient (m/km)	0.4
Flow character	placid
Total pools (%)	90
Pattern	irregularly meandering
Confinement	occasionally confined
Unstable banks (%)	20
Substrate composition (%)	
fines (<2 mm)	90
gravels (2-64 mm)	0
larges (>64 mm)	10
bedrock and/or oil sand	0
Debris	high

### REACH DESCRIPTION AND FISH UTILIZATION

This is the longest of the reaches in the surveyed portion of the Marguerite River, and it is essentially a long, irregularly meandering placid pool. Water velocities and gradient are the lowest in the surveyed portion of the river. Most of the substrate in the reach is fines, but larges are present in some areas. Riparian vegetation is dominated by coniferous trees and deciduous shrubs and a relatively high proportion of the channel area is covered by overhanging vegetation. Large quantities of debris are present in this reach.

The substrate material in this reach is not suitable for spawning by the majority of the fish species captured in the reach. A few forage fish that normally spawn over sandy substrates would find ample suitable spawning areas in this reach. Large quantities of debris, an abundance of overhanging vegetation, and low water velocities provide good to excellent rearing areas in the reach. Very high numbers of young fish, particularly lake chub, were captured here in September. Excellent resting and feeding habitat for larger fish in the reach is provided by the many pools and areas sheltered by overhanging vegetation and debris. Piscivores have an abundant food supply in this reach. Although there are many pools in the reach, they may not be deep enough for fish to overwinter in.

### BENTHIC INVERTEBRATES

OLIGOCHAETA HIRUDINEA PELECYPODA Musculium INSECTA Hemiptera Trichoptera

Limnephilus/Philarctus Diptera Tipulidae Chironomidae Chironominae Tanypodinae Orthocladiinae

### RIPARIAN VEGETATION

Bank coverage (%) Coniferous trees Deciduous trees Shrubs 20 Grasses Barren Channel cover (%) Overhang Crown

### BENTHIC ALGAL PRODUCTIVITY

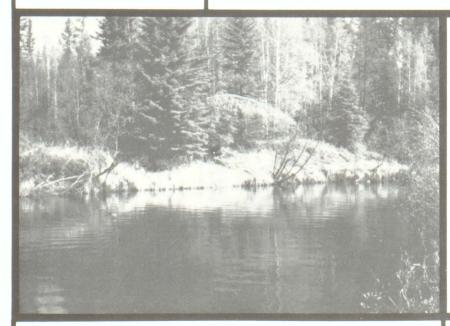
No data available for this reach

### STREAM GAUGING DATA

No data available for this reach

### WATER QUALITY

No data available for this reach



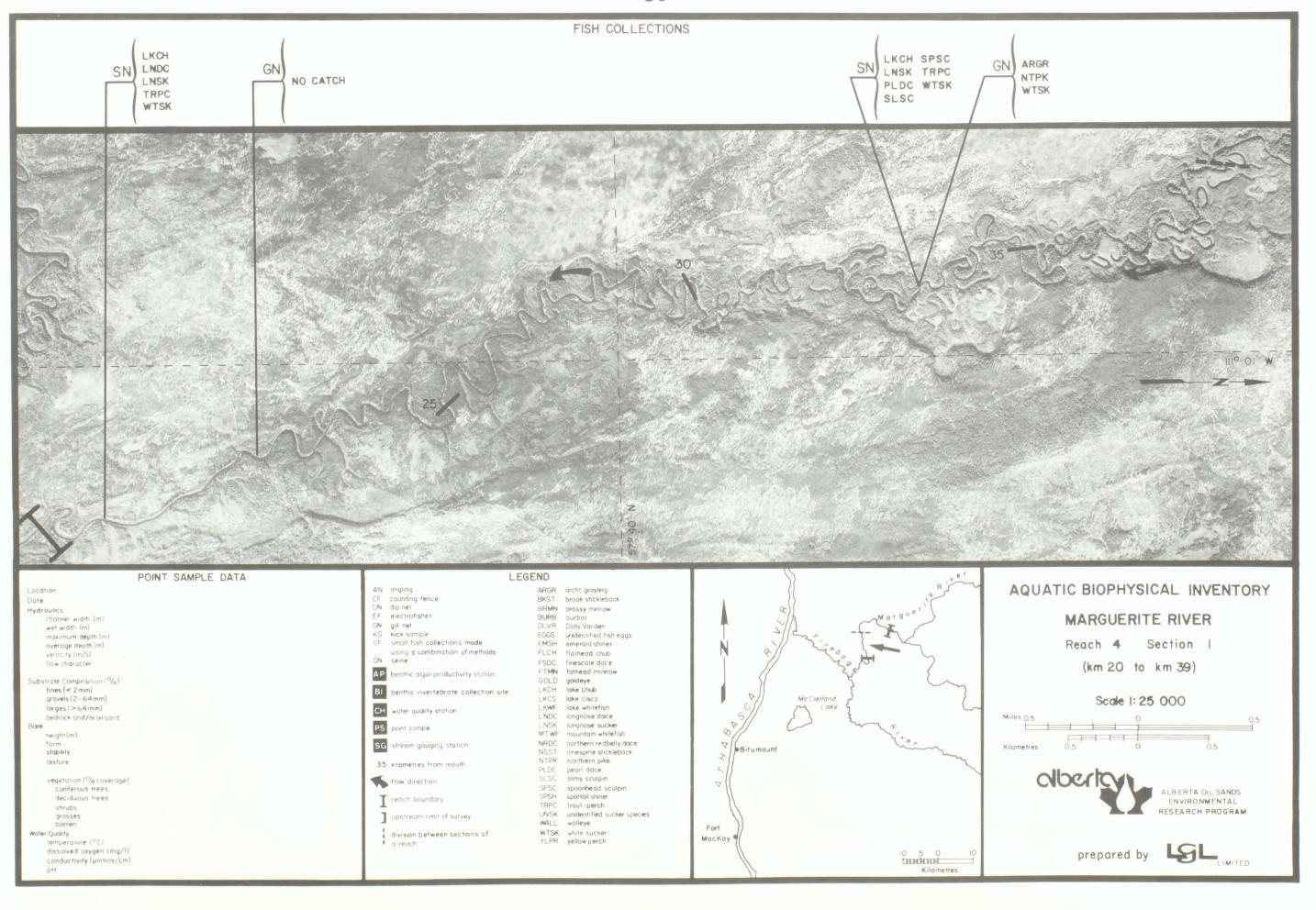
Slow-moving pool at km 45 is representative of reach 4.

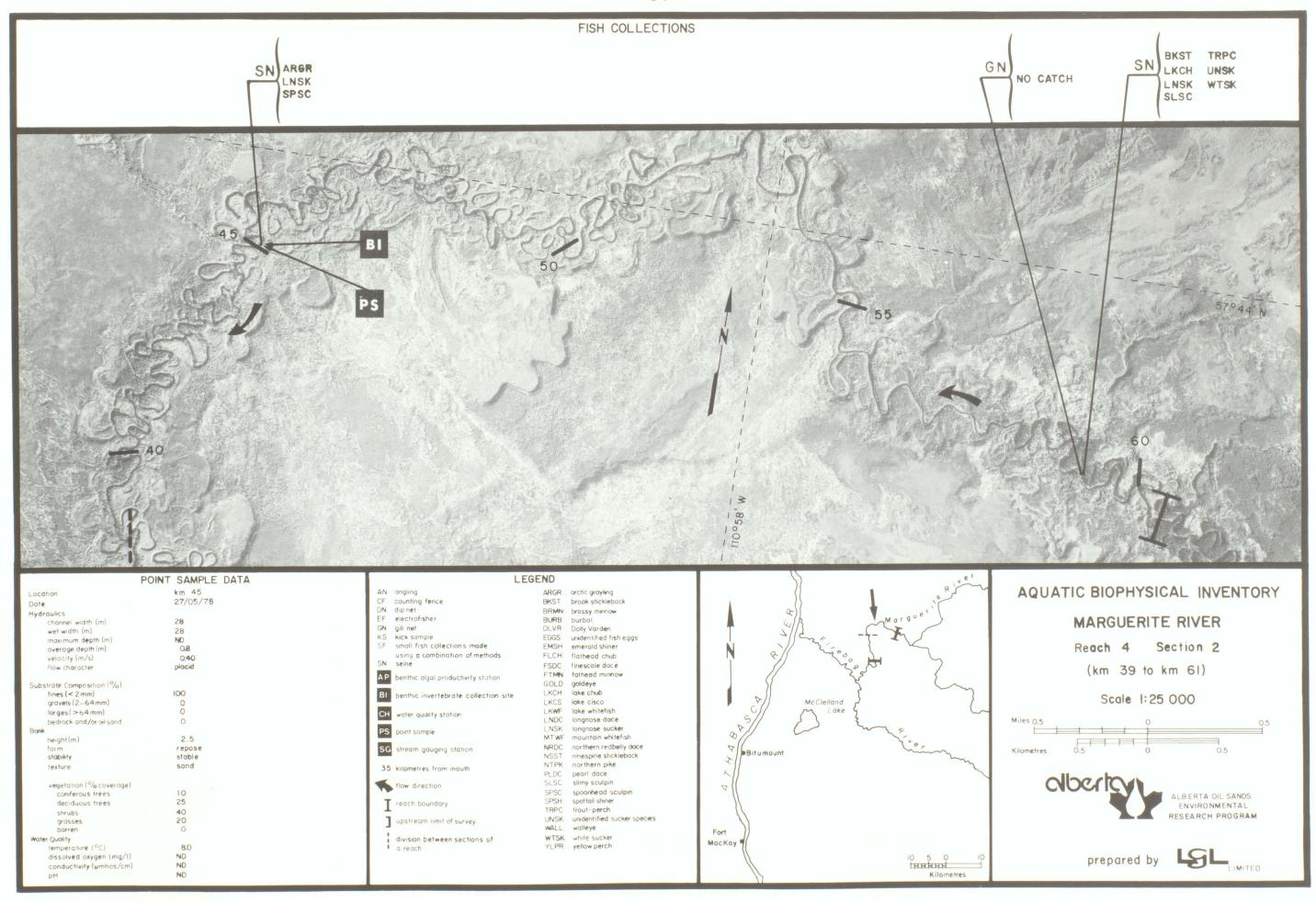
# AQUATIC BIOPHYSICAL INVENTORY MARGUERITE RIVER

Reach 4 (km 20 to km 61)









	Adults		Juveniles and Young-of-the-year		Total Numbers	
Species	May	September	May	September	May	September
arctic grayling	0	ND	6	ND	6	ND
slimy sculpin	3	ND	7	ND	10	ND
Total	3	ND	13	ND	16	ND

### PHYSICAL CHARACTERISTICS

Reach length (km)	14.	. 0
Channel width (m)	20	
Channel area (ha)	28.	. 0
Gradient (m/km)	0	. 8
Flow character	rolling,	broken
Total pools (%)	20	
Pattern	irregularly	meandering
Confinement	uncon	fined
Unstable banks (%)	5	
Substrate composition (%)		
fines (<2 mm)	20	
gravels (2-64 mm)	20	
larges (>64 mm)	40	
bedrock and/or oil sand	20	
Debris	high	h

### REACH DESCRIPTION AND FISH UTILIZATION

This reach is the uppermost section of the surveyed portion of the Marguerite River. It is an irregularly meandering section with stable banks. Gradient and water velocities are moderate and the majority of the reach is riffles. The substrate is characterized by an abundance of larges mixed with fines and gravels. Deciduous trees are the dominant component of the riparian vegetation and a relatively high proportion of the channel is shaded by overhanging vegetation. As in Reach 4, large quantities of debris are present in this reach.

Although very few fish were collected in this reach during the study, conditions are considered to be excellent for spawning of most fish species in the Marguerite River because of the diversity of water depths, water velocities and substrate sizes. An abundance of debris, overhanging vegetation, and rocky substrate materials provides good to excellent rearing conditions for most fish. The potential for resting and feeding of larger fish is considered to be only fair; the few pools present and those areas shaded by overhanging vegetation would be most suitable. Shallow water depths and the relative paucity of deep pools limit overwintering potential in this reach.

### BENTHIC INVERTEBRATES OLIGOCHAETA

HIRUDINEA Glossiphoniidae GASTROPODA

Stagnicola PELECYPODA

Musculium

Sphaerium INSECTA

Ephemeroptera Drunella Ephemerella Paraleptophlebia

Stenonema Odonata

Ophiogomphus Plecoptera

Claassenia Isoperla Pteronarcys

Trichoptera Glossosoma Hydropsyche

Lepidostoma Oecetis Polycentropus Coleoptera

Elmidae Diptera

Tipulidae Psychodidae Chironomidae Chironominae Tanypodinae Orthocladiinae

Simuliidae Rhagionidae Atherix Empididae

### RIPARIAN VEGETATION

Bank coverage (%) 15 Coniferous trees Deciduous trees Shrubs Grasses 10 Barren Channel cover (%) Overhang

Crown

### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

### STREAM GAUGING DATA

No data available for this reach

### WATER QUALITY

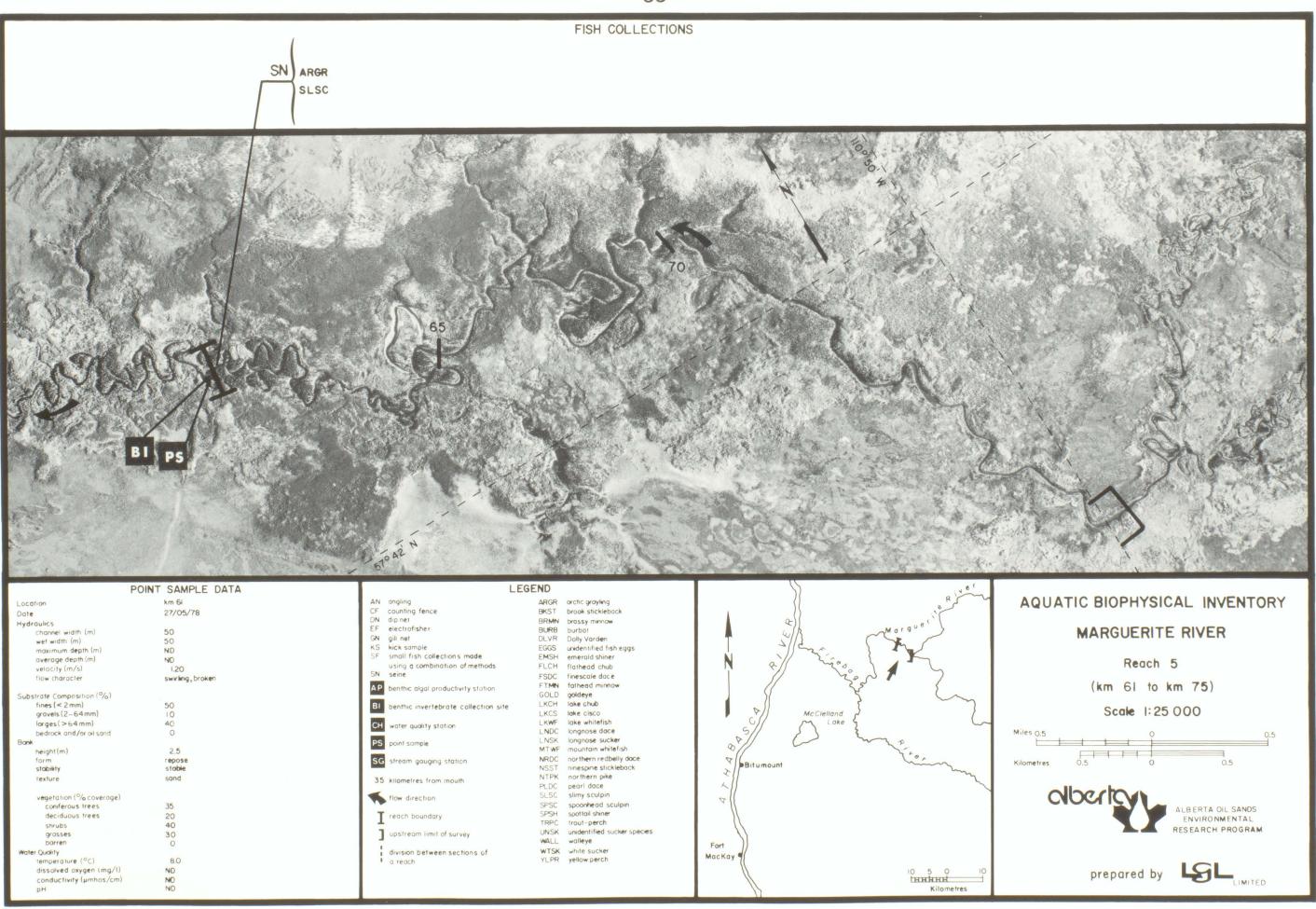
No data available for this reach

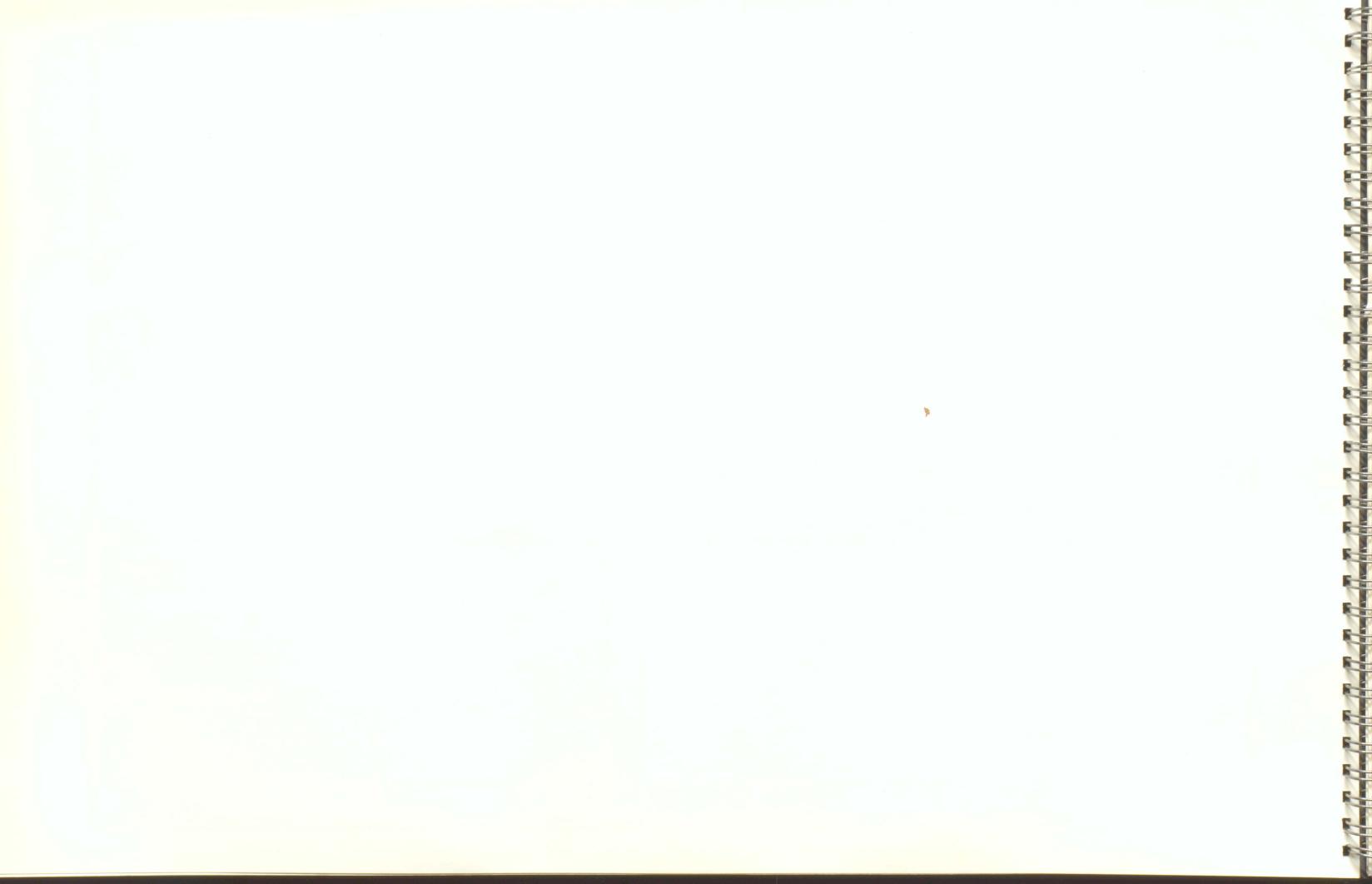
# AQUATIC BIOPHYSICAL INVENTORY MARGUERITE RIVER

Reach 5 (km 61 to km 75)

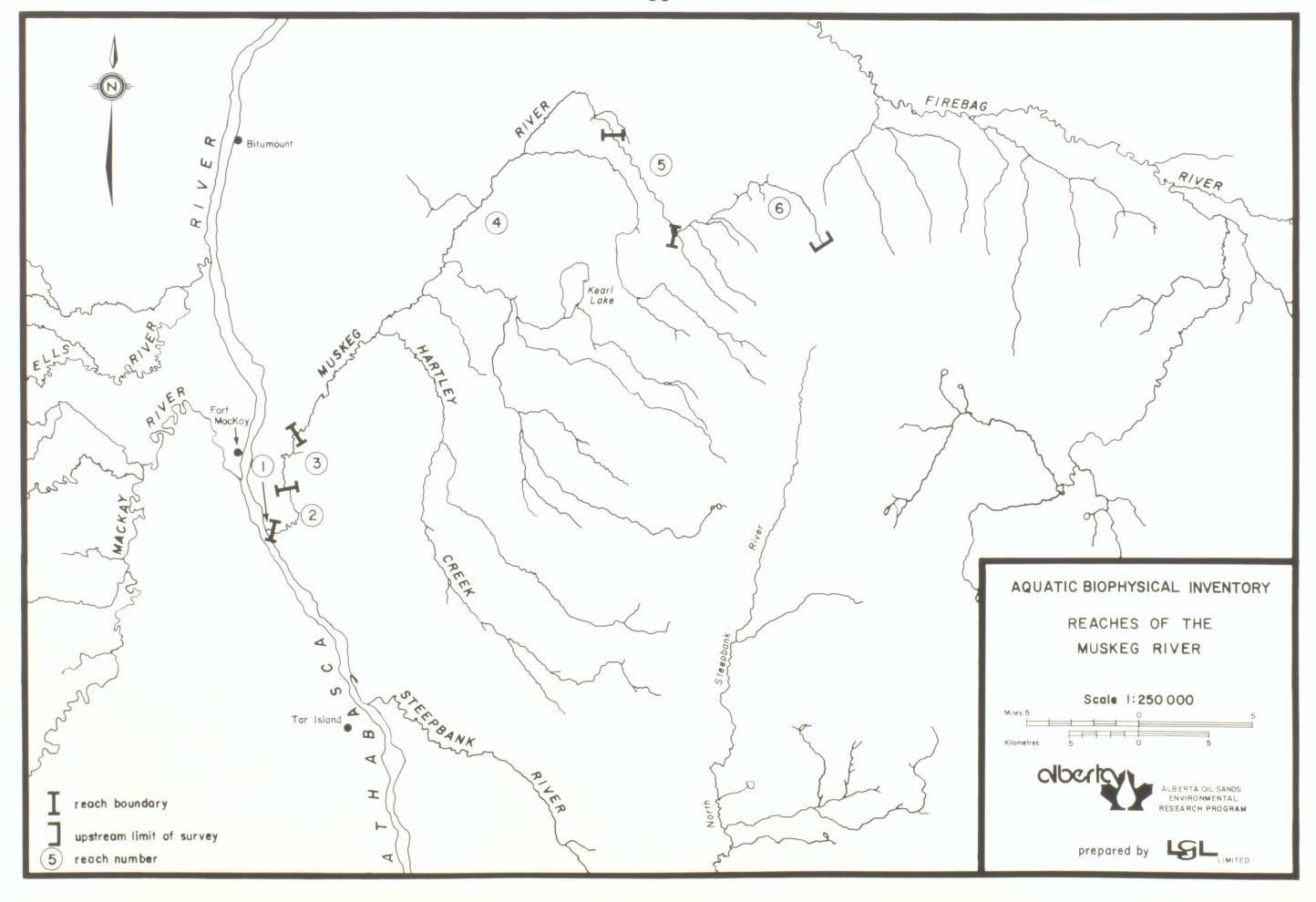








# MUSKEG RIVER



Species	Adults	Juveniles and Young-of-the-year	Total Numbers
pearl dace	0	2	2
slimy sculpin	0	2	2
Total	0	4	<del>-</del>

#### PHYSICAL CHARACTERISTICS

Reach length (km)	0.5
Channel width (m)	24
Channel area (ha)	1.2
Gradient (m/km)	3.5
Flow character	swirling, rolling
Total pools (%)	65
Pattern	sinuous
Confinement	unconfined
Unstable banks (%)	30
Substrate composition (%)	
fines (<2 mm)	20
gravels (2-64 mm)	50
larges (>64 mm)	30
bedrock and/or oil sand	0
Debris	low

#### REACH DESCRIPTION AND FISH UTILIZATION

This lower reach of the Muskeg River extends 0.5 km upstream from the confluence with the Athabasca River. It lies within the floodplain of the Athabasca River and is consequently influenced by fluctuations of water levels in that river. The gradient is moderately high, and although pools comprise the majority of the reach area, the presence of riffles is a prominent feature. There is a relatively high proportion of unstable banks. The substrate in most areas consists primarily of fines and gravels, but there are several areas with substrates containing substantial proportions of cobbles. The riparian vegetation is dominated by deciduous trees. Deciduous shrubs are also fairly abundant and some conifers are present. Little vegetation overhangs the river channel.

Although the sand and gravel substrates and the variety of water velocities in this reach would appear to provide areas suitable for spawning of several species of fish that occur in the Muskeg River (e.g., arctic grayling, longnose sucker, white sucker, trout-perch), most of these species are believed to spawn farther upstream in the Muskeg River. Rearing potential for most species is considered good; there are ample shallow backwater areas that provide suitable habitat. Juveniles and young-of-the-year of several species have been collected in this reach. The presence of forage species and young-of-the-year suckers in the mouth region of the Muskeg River would appear to provide good forage for piscivorous species. The mouth region may also be of some importance as a resting area during upstream migrations of some species (e.g., lake whitefish and walleye) in the Athabasca River. Water depths in this reach are generally shallow and may not be sufficient for overwintering of fish.

### BENTHIC INVERTEBRATES OLIGOCHAETA GASTROPODA

Gyraulus Stagnicola PELECYPODA Musculium INSECTA Ephemeroptera Diptera Chironomidae Chironominae Tabanidae

### RIPARIAN VEGETATION

Bank coverage (%) Coniferous trees Deciduous trees 70 Shrubs Grasses Barren Channel cover (%) Overhang Crown

#### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

#### STREAM GAUGING DATA

No data available for this reach

#### WATER QUALITY

Water Survey of Canada station number 00AT07DA0079

	Mean	Maximum	Minimum
Total alkalinity (mg CaCO <sub>3</sub> /1) pH	255.0 7.90	790.0	113.6 7.40
Total hardness (mg CaCO <sub>3</sub> /1)	229.2	638.3	97.4
Conductance (µS/cm)	473	1360	205
Total filterable			
residue fixed (mg/1)	241	728	90
Total non-filterable			
residue fixed (mg/1)	3	8	< 0.4
Total organic carbon (mg C/1)	25.0	63.0	10.0
Silica (mg SiO <sub>2</sub> /1)	15.0	57.0	2.6
Nitrate and nitrite nitrogen (mg N/1)	0.130	0.600	0.010
Total Kjeldahl nitrogen (mg N/1)	1.75	3.94	0.55
Total Phosphorus (mg P/1)	0.030	0.070	0.005
Orthophosphate (mg P/1)	0.010	0.020	0.004
Sulphate (mg SO <sub>4</sub> /1)	3.5	10.9	0.5

Data for the period January 1976 to December 1979 obtained from the National Water Quality Data Bank (NAQUADAT).

Muskeg River 30 m upstream from confluence with the Athabasca River.

Confluence of the Muskeg River with the Athabasca River.

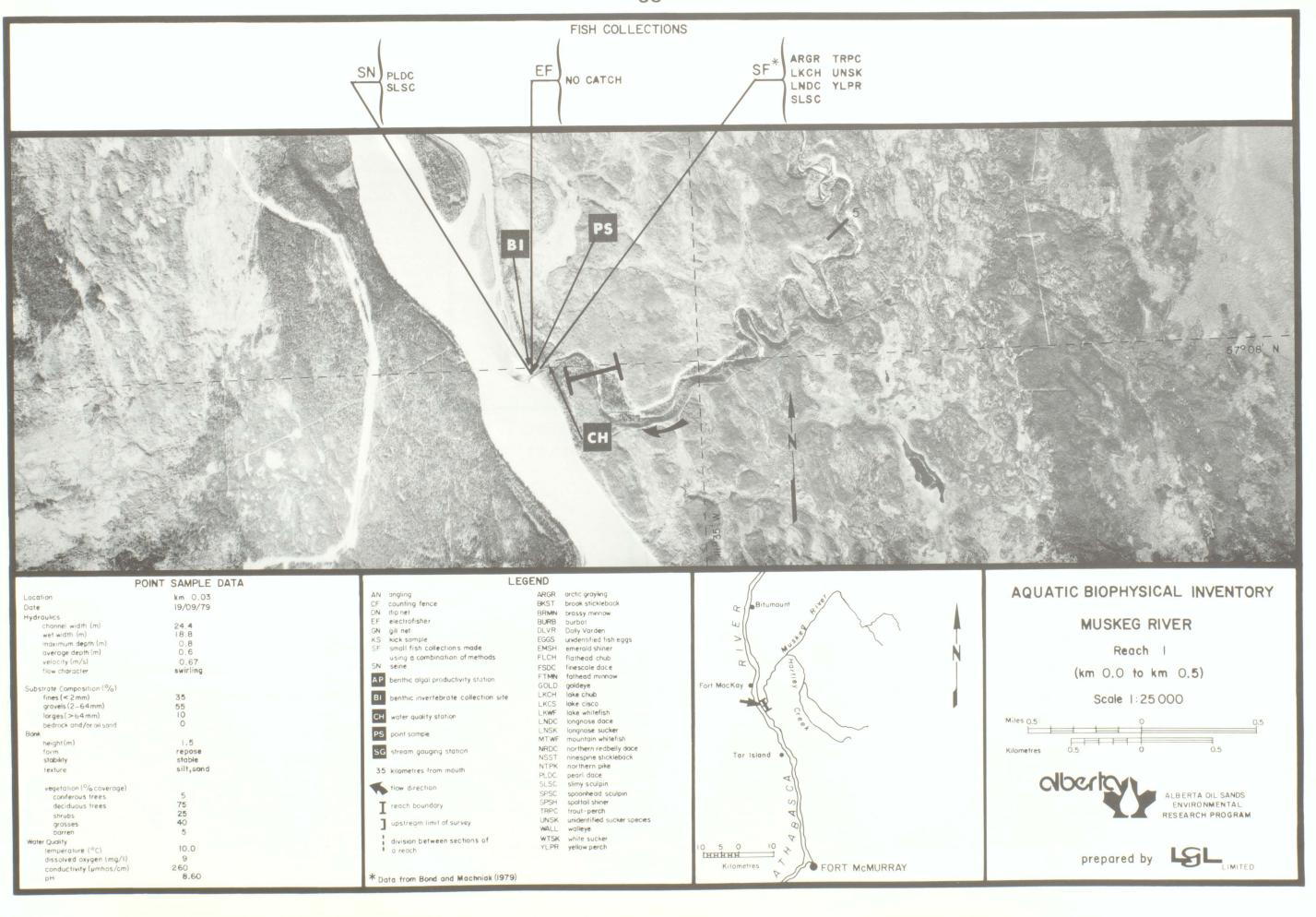
## AQUATIC BIOPHYSICAL INVENTORY MUSKEG RIVER

Reach I (km 0.0 to km 0.5)



ALBERTA OIL SANDS ENVIRONMENTAL RESEARCH PROGRAM

prepared by LSL LIMITED



Species	Adults	Juveniles and Young-of-the-year	Total Numbers
arctic grayling	0	2	2
longnose dace	0	4	4
pearl dace	3	8	11
slimy sculpin	1	11	12
white sucker	0	2	2
Total	4	27	31

#### PHYSICAL CHARACTERISTICS

Reach length (km)	8.5
Channel width (m)	15
Channel area (ha)	12.8
Gradient (m/km)	3.2
Flow character	swirling, rolling, broken
Total pools (%)	30
Pattern	irregularly meandering
Confinement	entrenched
Unstable banks (%)	55
Substrate composition (%)	
fines (<2 mm)	10
gravels (2-64 mm)	70
larges (>64 mm)	20
bedrock and/or oil sand	0
Debris	moderate

#### REACH DESCRIPTION AND FISH UTILIZATION

This irregularly meandering section of the Muskeg River is entrenched in a deep, narrow canyon with a high proportion of unstable banks. The high, slumping banks appear to be composed primarily of sand, gravel and silt. The gradient is relatively high and the reach is a series of alternating pools and riffles. The substrate consists primarily of gravels and larges, but some sand and silt are present in pool areas. The riparian vegetation is dominated by deciduous trees and shrubs, but coniferous trees are also fairly abundant. Little vegetation overhangs the river channel in this reach. Moderate amounts of woody debris are present along the edges of the channel.

The series of pools and riffles and the variety of substrates in this reach provide excellent spawning potential for many of the fish species that occur in the Muskeg River (e.g., arctic grayling, white sucker, longnose sucker, longnose dace, lake chub, slimy sculpin, trout-perch). The numerous shallow areas along the sides of the channel, where water velocities are low and debris provides some shelter, are good rearing areas for a variety of fish species. The many shallow gravel riffles provide good feeding areas for juvenile arctic grayling. The pools of this reach are very good areas for resting and feeding of larger fish, and the variety of forage species provides an abundant food source for piscivorous species. Water depths in the pools are moderately deep and at least some pool areas may be suitable overwintering sites for some fish.

## BENTHIC INVERTEBRATES GASTROPODA

Gyraulus

#### PELECYPODA Musculium

INSECTA

Ephemeroptera Baetisca Ephemerella

#### Odonata

Plecoptera

Isogenus Pteronarcys

#### Trichoptera

Brachycentrus Lepidostoma Oecetis

Coleoptera Dryopidae Elmidae

Diptera Tipulidae Chironomidae Chironominae Tanypodinae

Rhagionidae Dolichopodidae

### RIPARIAN VEGETATION

Bank coverage (%) Coniferous trees 15 Deciduous trees Shrubs Grasses Barren Channel cover (%) Overhang Crown

#### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

#### STREAM GAUGING DATA

No data available for this reach

#### WATER QUALITY

No data available for this reach



Muskeg River at km 4.2.



Unstable bedrock and gravel bank at km 7.

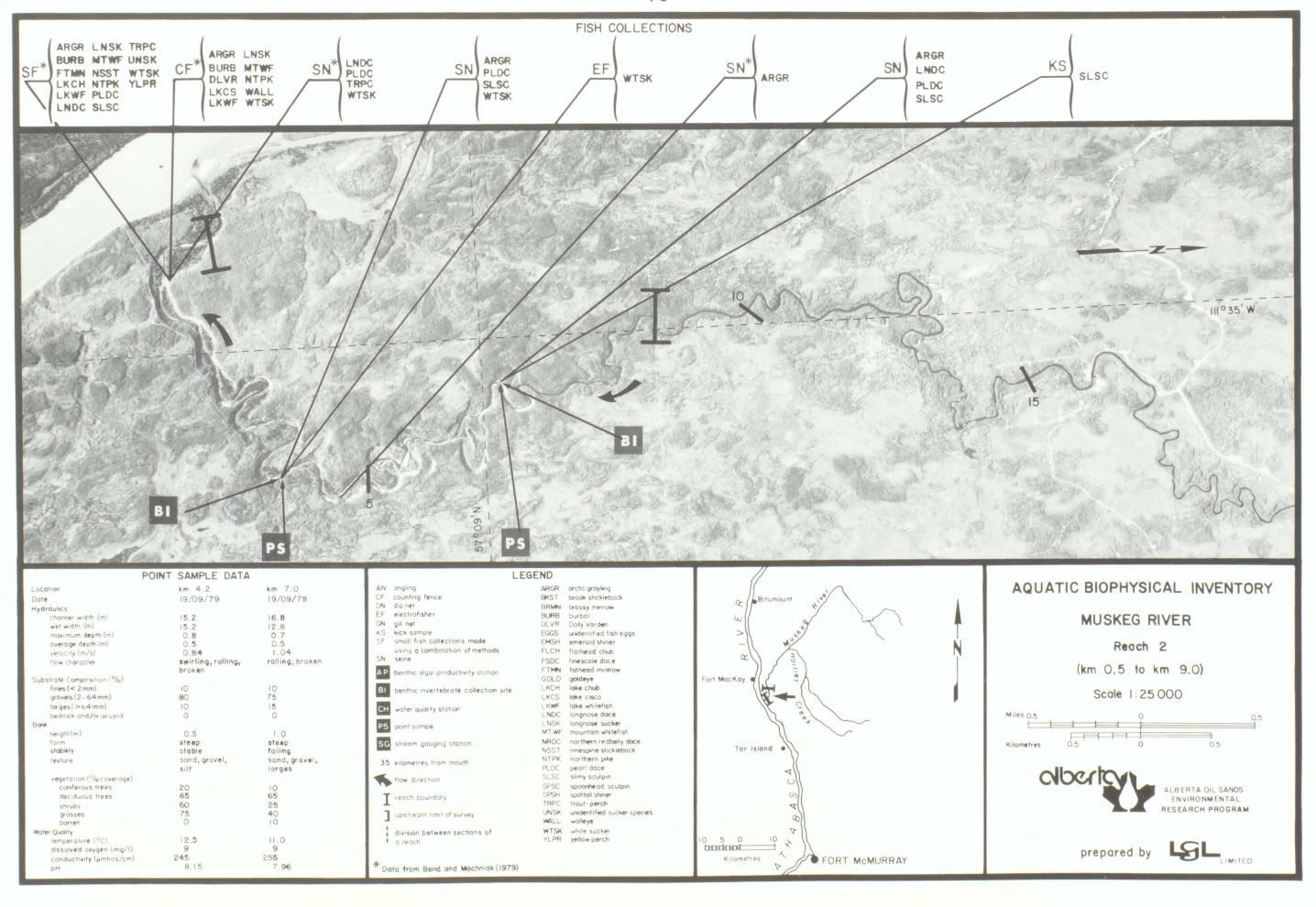
## AQUATIC BIOPHYSICAL INVENTORY MUSKEG RIVER

Reach 2 (km 0.5 to km 9.0)



ALBERTA OIL SANDS ENVIRONMENTAL





Species	Adults	Juveniles and Young-of-the-year	Total Numbers
longnose sucker	0	2	2
northern pike	2	2	4
pearl dace	0	17	17
slimy sculpin	1	1	2
Total	-	22	25

#### PHYSICAL CHARACTERISTICS

Reach length (km)	7.5
Channel width (m)	14
Channel area (ha)	10.5
Gradient (m/km)	1.0
Flow character	placid, swirling, rolling
Total pools (%)	80
Pattern	irregularly meandering
Confinement	occasionally confined
Unstable banks (%)	10
Substrate composition (%)	
fines (<2 mm)	30
gravels (2-64 mm)	50
larges (>64 mm)	20
bedrock and/or oil sand	0
Debris	moderate

#### REACH DESCRIPTION AND FISH UTILIZATION

This relatively short and irregularly meandering section of the Muskeg River is a region of transition between the low gradient Reach 4 and the high gradient Reach 2. The gradient is moderate and the flow character is mixed, varying from placid to swirling to rolling. Most of the reach area is composed of pools. The substrate is composed mainly of sand, gravels and cobbles, but some silt is present in pools and backwaters. The riparian vegetation is mostly deciduous trees and shrubs, with some conifers in the lower portion of the reach. Some vegetation overhangs the channel in most areas. Moderate amounts of debris are present along the edges of the river channel.

The spawning potential of this reach is good for those species that spawn over gravel substrates (e.g., arctic grayling, longnose sucker, white sucker, trout-perch, longnose dace). There are a few backwater areas with low to moderate amounts of aquatic vegetation that may provide suitable habitat for limited spawning of northern pike and brook stickleback in this reach. The numerous shallow areas with low water velocities and gravel substrates, the occasional weedy shallows, and the moderate amounts of debris and overhanging vegetation provide good rearing habitat. In most areas of this reach the water is moderately deep, and at least some of the pools are probably suitable for overwintering of fish.

## BENTHIC INVERTEBRATES GASTROPODA

INSECTA

PELECYPODA Musculium

Ephemeroptera

Paraleptophlebia Stenonema

Odonata Plecoptera

Hemiptera Corixidae Trichoptera Cheumctopsyche Lepidostoma

Coleoptera Elmidae Diptera Chironomidae Tanypodinae Tabanidae Dolichopodidae

#### RIPARIAN VEGETATION

Bank coverage (%) 10 Coniferous trees 65 Deciduous trees Shrubs Grasses Barren Channel cover (%) Overhang Crown

### BENTHIC ALGAL PRODUCTIVITY

Standing crop expressed as cell counts (number·m<sup>-2</sup>) mean: 1.9 x 101  $3.9 \times 10^{10}$ maximum:  $1.1 \times 10^{10}$ Standing crop expressed as chlorophyll  $\alpha$  (mg·m<sup>-2</sup>) mean: maximum: 65.7 Primary productivity (mg C·h<sup>-1</sup>·m<sup>-2</sup>)

26.5 mean: maximum: 107.8 minimum: 6.9

Data from Hickman et al. (1980).

#### TREAM GAUGING DATA

Water Survey of Canada station number 07DA008

Maximum total annual discharge:  $199.8 \times 10^6 \text{ m}^3 \text{ (1974)}$ Minimum total annual discharge:  $65.6 \times 10^6 \text{ m}^3$  (1976) Maximum annual mean discharge: Minimum annual mean discharge: 2.07 m<sup>3</sup>/s (1976) Maximum monthly mean discharge: 21.95 m<sup>3</sup>/s (September 1978) Minimum monthly mean discharge: 0.21 m<sup>3</sup>/s (December 1976) Maximum daily discharge: 42.19 m<sup>3</sup>/s (Apr. 28, 1974 Minimum daily discharge: 0.14 m<sup>3</sup>/s (Dec. 17, 1976)

Data for 1974 to 1978 compiled from Loeppky and Spitzer (1977) Warner and Spitzer (1979) and Warner (1979).



Swirling and rolling flow, common in this reach, at km 10.4.



A large, swirling pool at km 13.8.

Water Survey of Canada station number 00AT07DA0080

	Mean	Maximum	Minimum
Total alkalinity (mg CaCO <sub>3</sub> /1) pH	172.4 7.80	289.0	55.7 7.28
Total hardness (mg CaCO <sub>3</sub> /1)	171.5	280.9	59.7
Conductance (µS/cm)	309	520	115
Total filterable			
residue fixed (mg/1)	156	308	49
Total non-filterable			
residue fixed (mg/1)	2	39	< 0.4
Total organic carbon (mg C/1)	25.0	53.0	6.0
Silica (mg SiO <sub>2</sub> /1)	9.0	25.0	1.8
Nitrate and nitrite nitrogen (mg N/1)	0.040	0.310	< 0.003
Total Kjeldahl nitrogen (mg N/1)	1.20	3.00	0.28
Total Phosphorus (mg P/1)	0.040	0.190	0.005
Orthophosphate (mg P/1)	0.010	0.041	< 0.003
Sulphate (mg SO <sub>4</sub> /1)	5.3	42.5	0.1

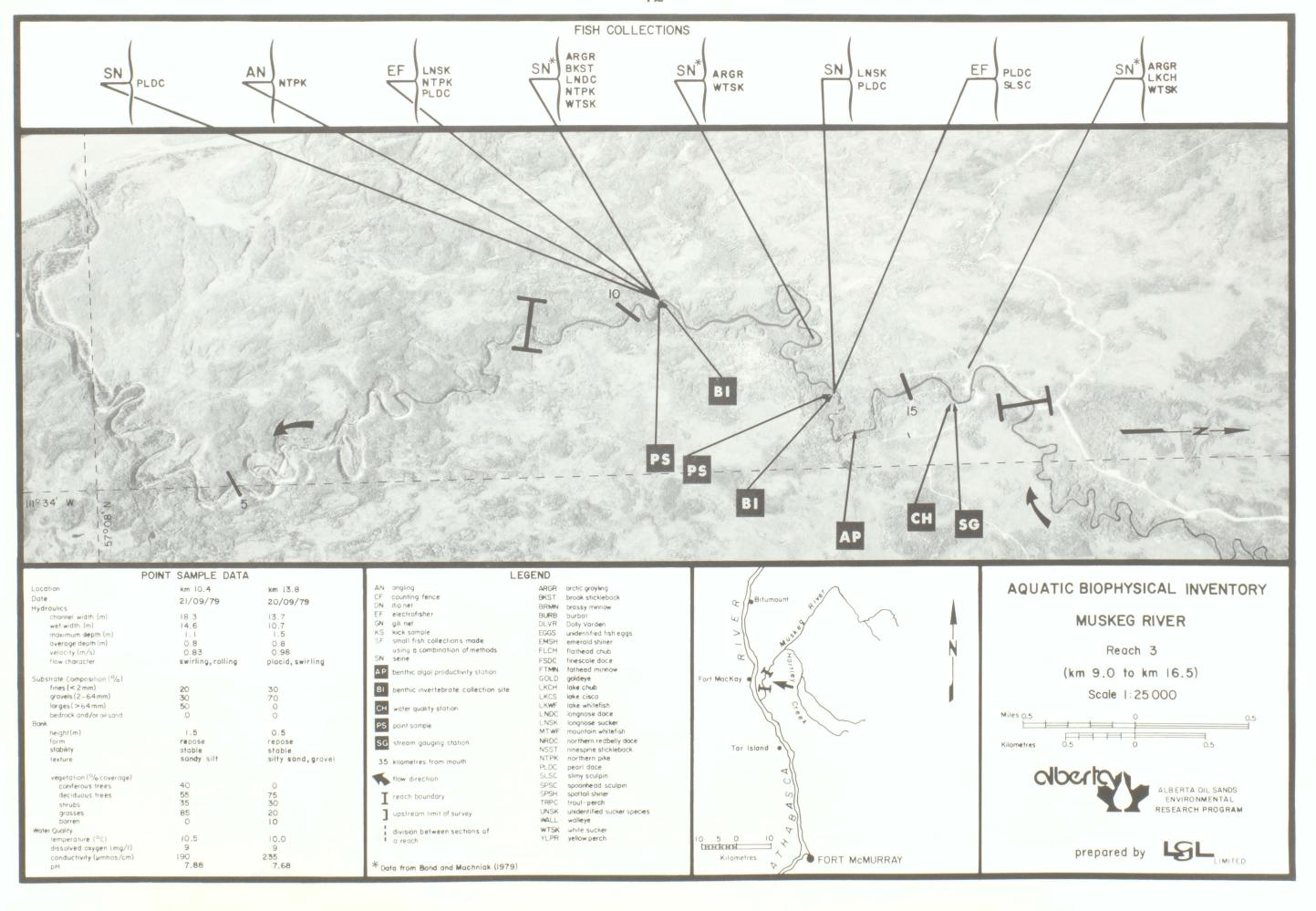
Data for the period January 1976 to December 1979 obtained from the National Water Quality Data Bank (NAQUADAT).

## AQUATIC BIOPHYSICAL INVENTORY MUSKEG RIVER

Reach 3 (km 9.0 to km 16.5)







Species	Adults	Juveniles and Young-of-the-year	Total Numbers
pearl dace	0	Ï	1
white sucker	0	1	1
Total	0	2	2

#### PHYSICAL CHARACTERISTICS

Reach length (km)	63.5
Channel width (m)	10
Channel area (ha)	63.5
Gradient (m/km)	0.3
Flow character	placid
Total pools (%)	95
Pattern	tortuously meandering, irregularly meandering
Confinement	unconfined
Unstable banks (%)	0
Substrate composition (%)	
fines (<2 mm)	100
gravels (2-64 mm)	0
larges (>64 mm)	0
bedrock and/or oil sand	0
Debris	moderate

#### REACH DESCRIPTION AND FISH UTILIZATION

This long, low-gradient reach meanders through a large area of marshy treed muskeq. The reach is nearly all pools and the water flow is slow. The stream is deep and the banks drop off sharply at the edge of the channel. There are many beaver dams in this reach, particularly upstream from Hartley Creek. The substrate is entirely silt and sand with moderate to very high organic detritus content. Aquatic vegetation is abundant. The riparian vegetation is almost entirely deciduous trees and shrubs with a very dense growth of grasses. Channel cover due to overhanging shrubs varies from moderate in the lower portion of the reach to very high in the upper portion of the reach. Channel debris also varies from moderate to high.

The abundant aquatic vegetation in this reach provides numerous areas suitable for spawning of brook stickleback and northern pike. The reach does not appear to be suitable for spawning of other species. Rearing potential is good because there is ample shelter provided by woody debris and aquatic vegetation. Water depths in this reach appear to be sufficient to allow overwintering of fish.

#### ENTHIC INVERTEBRATES

OLIGOCHAETA GASTROPODA

PELECYPODA

CRUSTACEA Cladocera Copepoda

Amphipoda

INSECTA Ephemeroptera

Plecoptera Hemiptera Corixidae

Megaloptera Trichoptera

> Chironominae Tanypodinae

Diptera Chironomidae

### RIPARIAN VEGETATION

Bank coverage (%) Coniferous trees Deciduous trees 80 Shrubs 15 Grasses 95 Barren Channel cover (%) Overhang 10 Crown

#### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

#### STREAM GAUGING DATA

No data available for this reach

## WATER QUALITY

Water Survey of Canada station number 00AT07DA0085

	Mean	Maximum	Minimum
Total alkalinity (mg CaCO <sub>3</sub> /1) pH	212.3 7.60	327.2 8.20	76.0 7.10
Total hardness (mg CaCO <sub>3</sub> /1)	207.7	327.6	74.6
Conductance (µS/cm)	380	610	120
Total filterable			
residue fixed (mg/1)	203	331	79
Total non-filterable			
residue fixed (mg/l)	4	30	< 0.4
Total organic carbon (mg C/1)	25.0	45.0	10.0
Silica (mg SiO <sub>2</sub> /1)	11.2	17.0	4.2
Nitrate and nitrite nitrogen (mg N/1)	0.030	0.140	0.005
Total Kjeldahl nitrogen (mg N/1)	1.45	5.50	0.50
Total Phosphorus (mg P/1)	0.080	0.250	0.020
Orthophosphate (mg P/1)	0.010	0.030	0.006
Sulphate (mg SO <sub>4</sub> /1)	3.7	9.2	0.1

Data for the period January 1976 to December 1979 obtained from the National Water Quality Data Bank (NAQUADAT).

#### Placid flow and heavily grassed banks at km 27.5 are typical of this reach.

Dense overhanging bank vegetation at km 42.

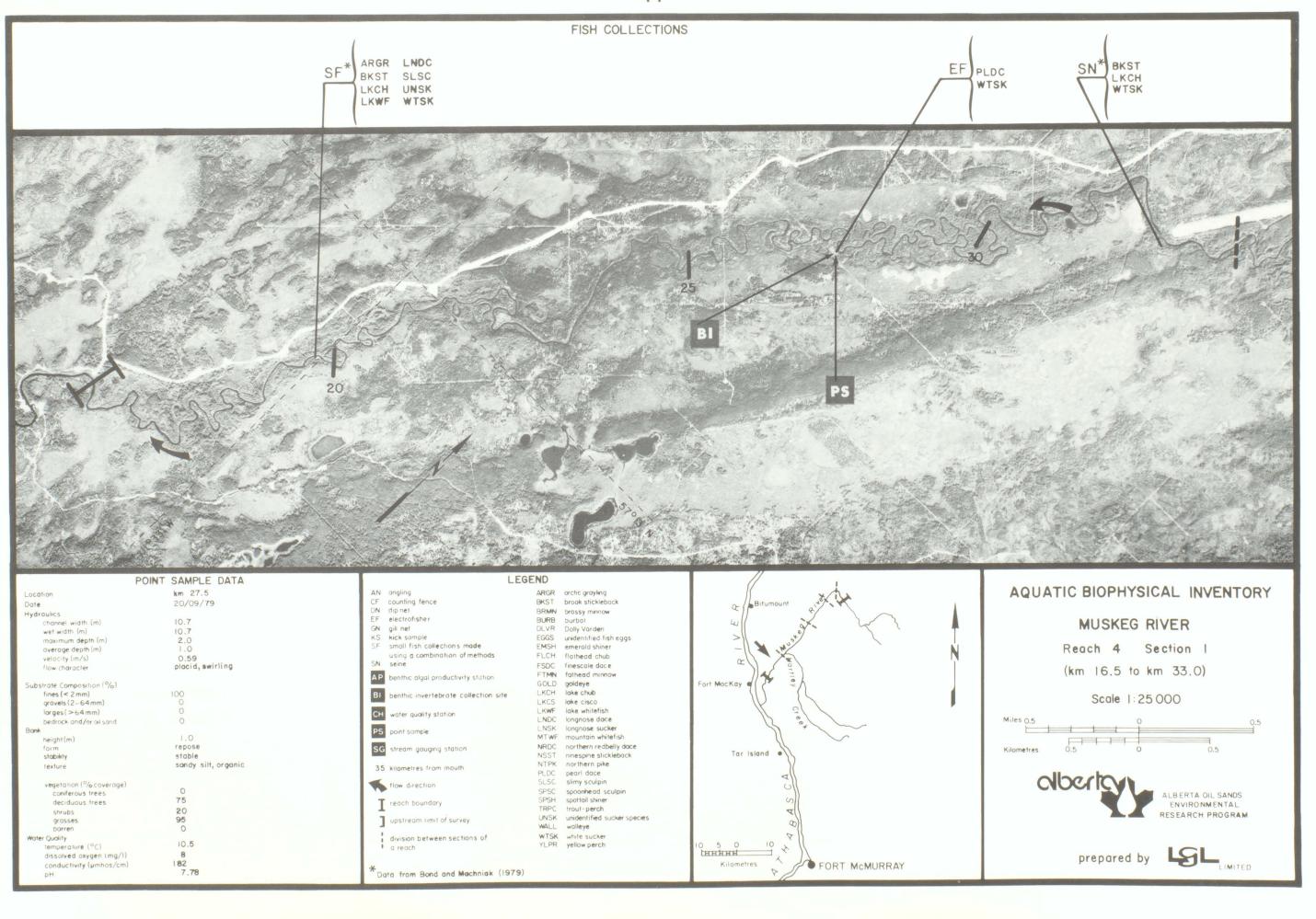
## AQUATIC BIOPHYSICAL INVENTORY MUSKEG RIVER

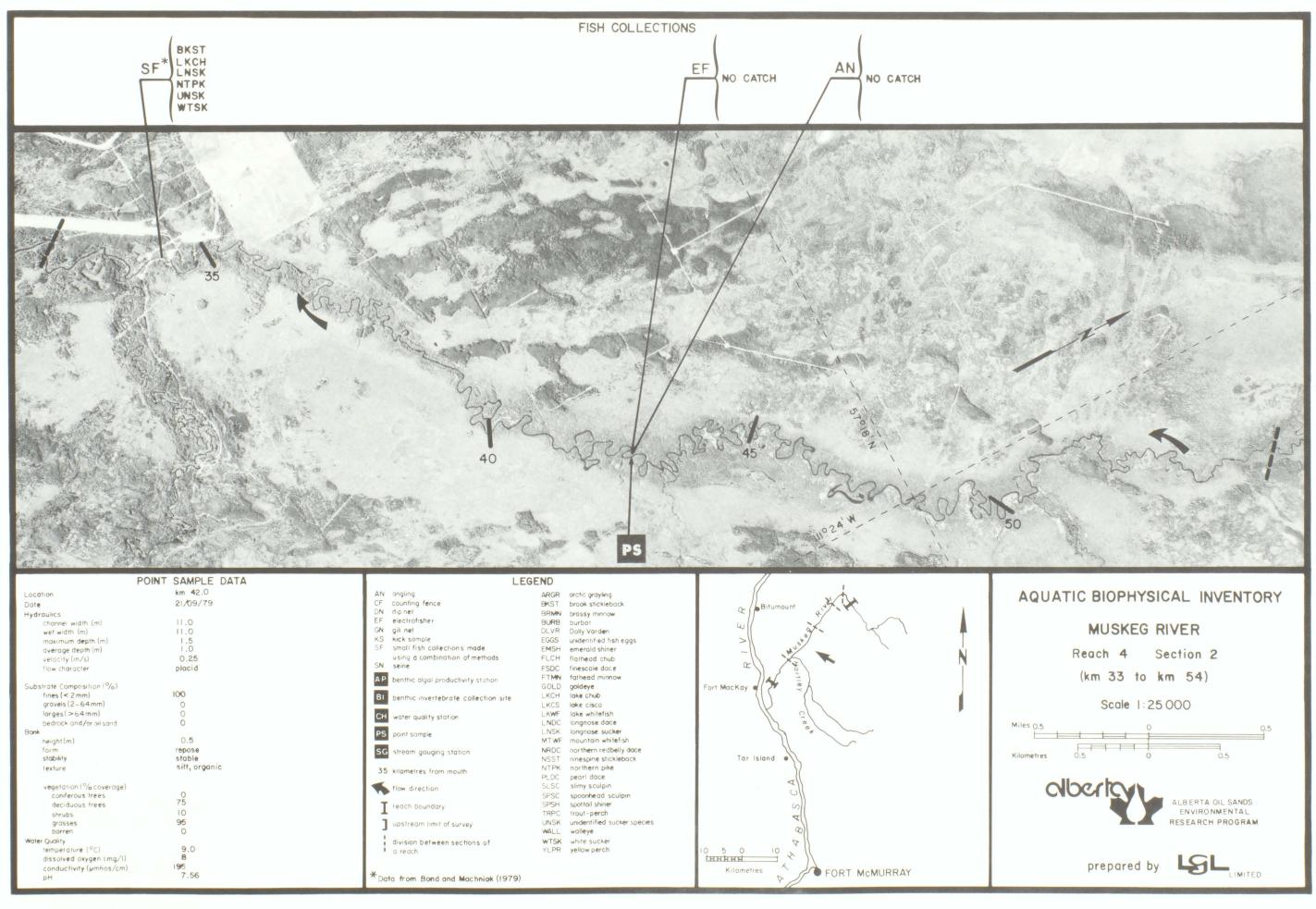
Reach 4 (km 16.5 to km 80.0)



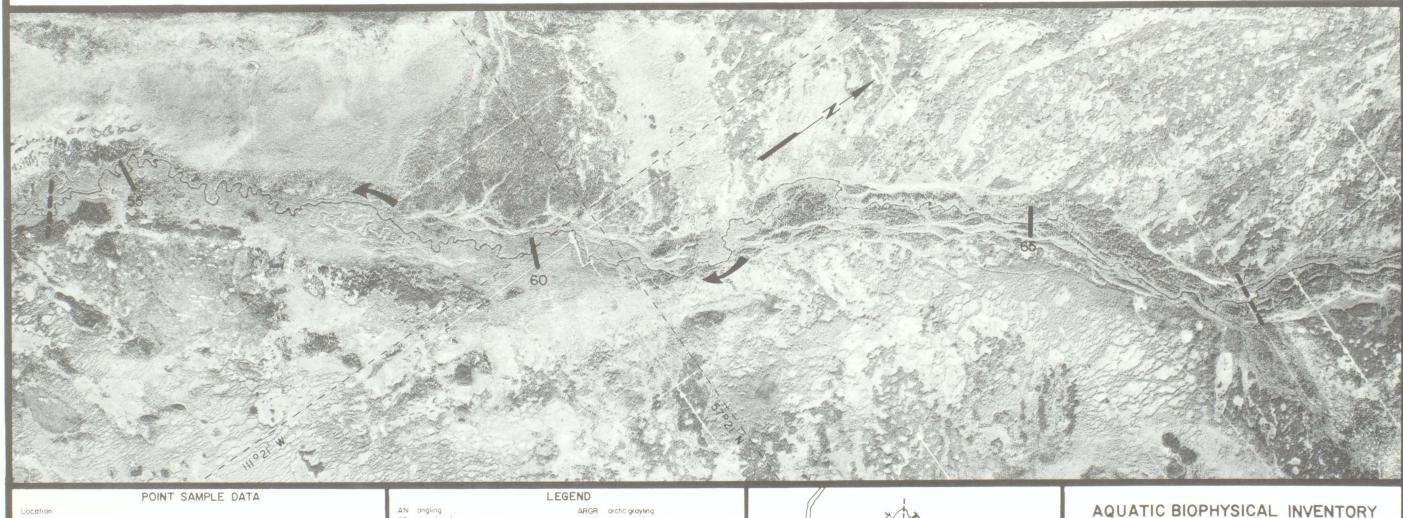
ALBERTA OIL SANDS ENVIRONMENTAL





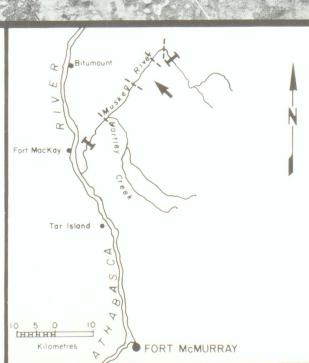


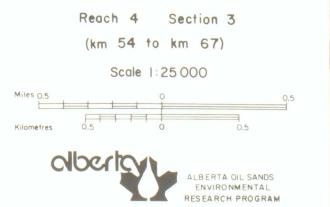




#### Location Date Hydraulics channel width (m) maximum depth (m) average depth (m) velocity (m/s) Substrate Composition (%) fines (< 2 mm) gravels (2-64 mm) larges(>64mm) bedrock and/or oil sand stability texture vegetation (% coverage) conferous trees deciduous trees shrubs barren Water Quality dissolved oxygen (mg/l) conductivity (µmhos/cm)

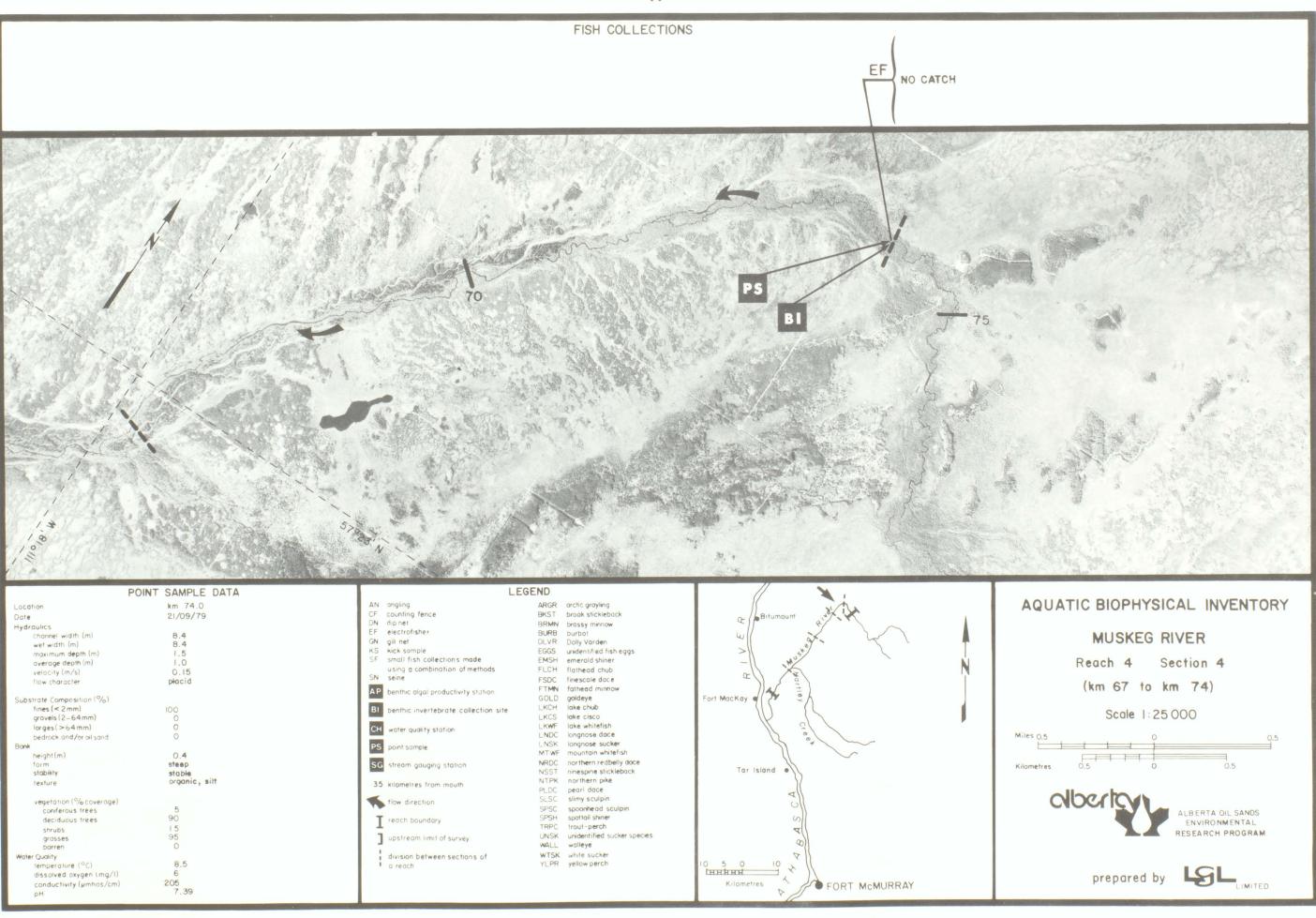
#### ARGR arctic grayling BKST brook stickleback DN dip net EF electrofisher BRMN brassy minnow BURB burbot DLVR Dolly Varden EGGS unidentified fish eggs GN gill net SF small fish collections made using a combination of methods SN seine FLCH flathead chub FSDC finescale dace AP benthic algal productivity station FTMN fathead minnow GOLD goldeye BI benthic invertebrate collection site LKCS lake cisco CH water quality station LKWF lake whitefish LNDC longnose dace PS point sample LNSK longnose sucker MTWF mountain whitefish SG stream gauging station NRDC northern redbelly dace NSST ninespine stickleback 35 kilometres from mouth PLDC pearl dace SLSC slimy sculpin flow direction SPSC spoonhead sculpin SPSC spoonneda scuipin SPSH spottail shiner TRPC trout-perch UNSK unidentified sucker species WALL walleye T reach boundary upstream limit of survey WTSK white sucker YLPR yellow perch division between sections of a reach

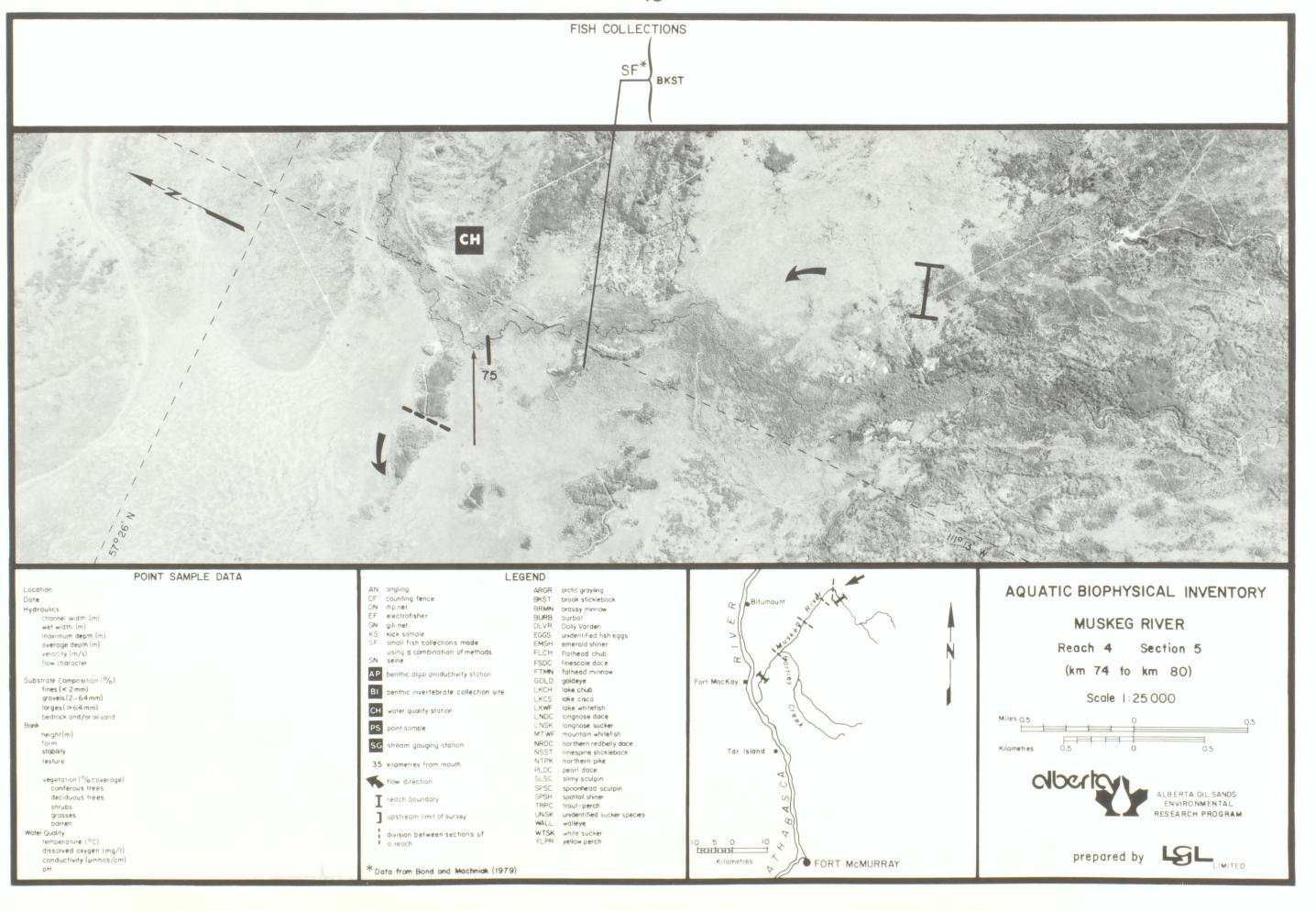




MUSKEG RIVER







Species	Adults	Juveniles and Young-of-the-year	Total Numbers
brook stickleback	2	2	4
pearl dace	0	2	2
white sucker	0	2	2
Total	2	6	8

### PHYSICAL CHARACTERISTICS

Reach length (km)	13.0
Channel width (m)	9
Channel area (ha)	11.7
Gradient (m/km)	2.8
Flow character	placid, swirling
Total pools (%)	90
Pattern	irregularly meandering
Confinement	occasionally confined
Unstable banks (%)	0
Substrate composition (%)	
fines (<2 mm)	80
gravels (2-64 mm)	10
larges (>64 mm)	10
bedrock and/or oil sand	0
Debris	high

#### REACH DESCRIPTION AND FISH UTILIZATION

This section of the Muskeg River has a much higher gradient than does Reach 4. The reach is almost entirely pools, however, because the flow is impeded by numerous beaver dams. The substrate is generally sand and silt with moderate organic detritus content, but there are some areas with fairly high proportions of gravels and cobbles. Coniferous trees dominate the riparian vegetation over much of the reach, but deciduous trees and shrubs are also abundant and there is a dense growth of grasses. Channel cover is very high due to overhanging shrubs. Sunken woody debris is abundant.

Movement of the larger fish into this reach from downstream regions is severely limited by beaver dams. Only brook stickleback, lake chub, pearl dace, and a few young-of-the-year white suckers have been collected in this reach. The brook stickleback, lake chub, and pearl dace are almost certainly year-round residents of this reach.

#### BENTHIC INVERTEBRATES OLIGOCHAETA GASTROPODA

PELECYPODA

INSECTA

Ephemeroptera

Odonata Libellulidae Plecoptera

Hemiptera Corixidae Trichoptera

Coleoptera Elmidae Diptera Ceratopogonidae Chironomidae

Chironominae Tanypodinae Orthocladiinae

#### RIPARIAN VEGETATION

Bank coverage (%) 60 Coniferous trees Deciduous trees 35 Shrubs 15 Grasses 90 Barren Channel cover (%) Overhang Crown 30

#### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

#### STREAM GAUGING DATA

No data available for this reach

#### WATER QUALITY

Water Survey of Canada station number 00AT07DA0094

	IICall	Haximan	re i i i i i i i i i i i i i i i i i i i
Total alkalinity (mg CaCO <sub>3</sub> /1) pH Total hardness (mg CaCO <sub>3</sub> /1) Conductance (µS/cm)	7.80	720.0 8.00 656.0	74.2 7.50 78.3
Total filterable	7.1 /:	1200	1 12
residue fixed (mg/1)	206	691	81
Total non-filterable			
residue fixed (mg/1)	7	30	< 0.4
Total organic carbon (mg C/1)	21.0	29.0	12.0
Silica (mg SiO <sub>2</sub> /1)	19.0	72.0	4.0
Nitrate and nitrite nitrogen (mg N/1)	0.010	0.010	< 0.003
Total Kjeldahl nitrogen (mg N/1)	2.05	4.90	0.39
Total Phosphorus (mg P/1)	0.130	0.320	0.031
Orthophosphate (mg P/I)	0.020	0.060	0.010
Sulphate (mg SO <sub>4</sub> /1)	4.6	8.5	0.5

Data for the period January 1976 to December 1979 obtained from the National Water Quality Data Bank (NAQUADAT).

# AQUATIC BIOPHYSICAL INVENTORY MUSKEG RIVER

Reach 5 (km 80 to km 93)



ALBERTA OIL SANDS ENVIRONMENTAL

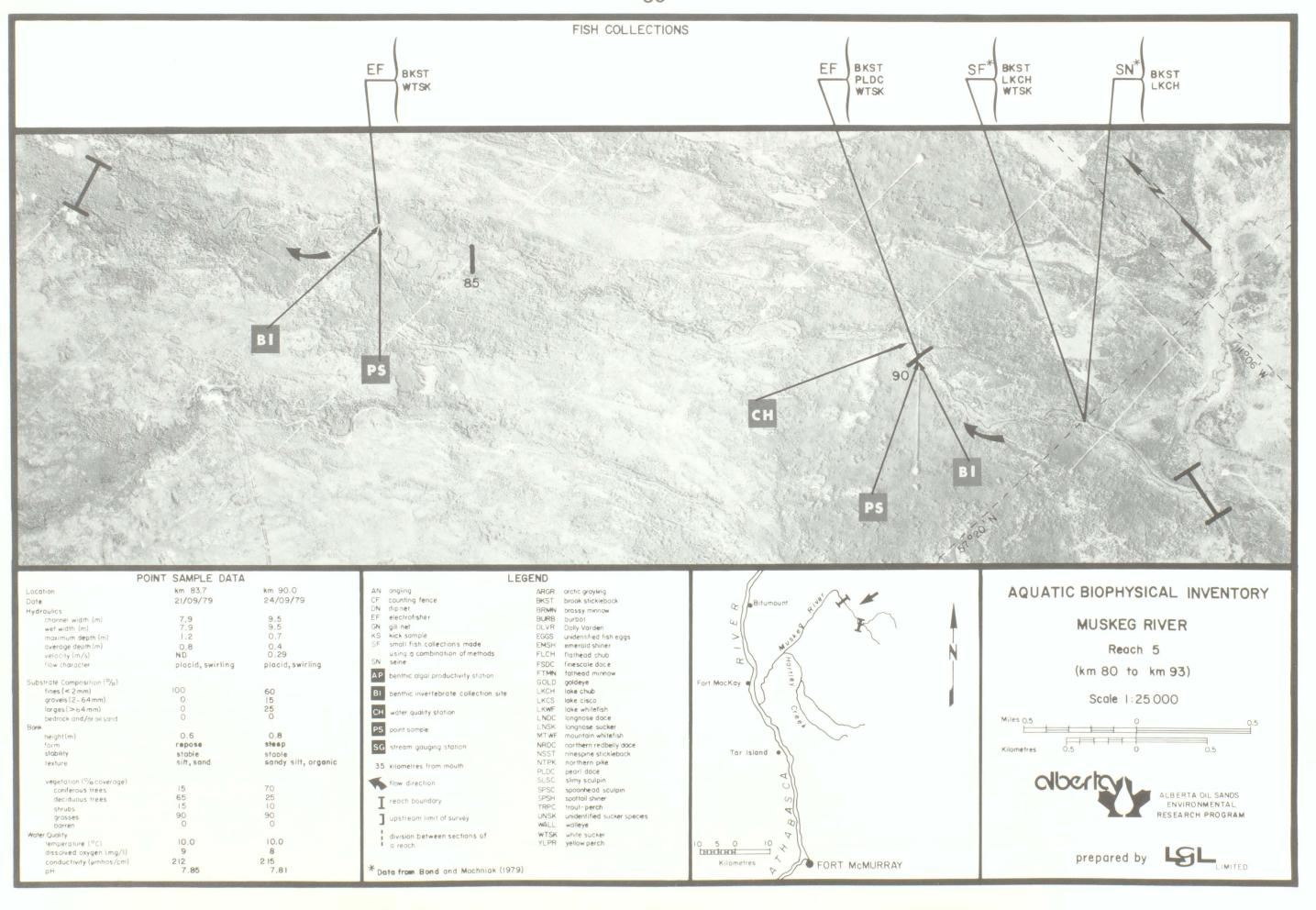
Mean Maximum Minimum





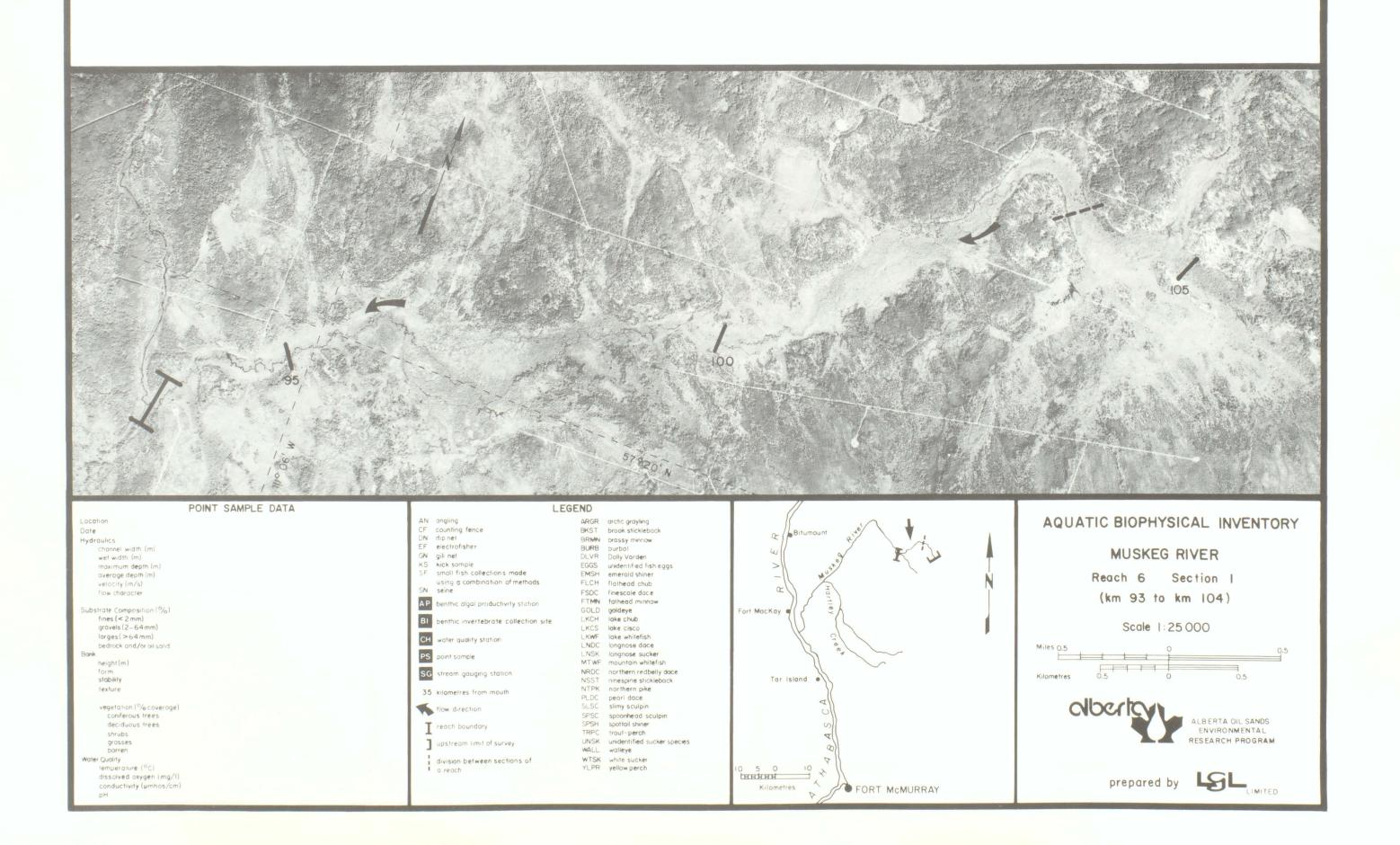
Dense overhanging bank vegetation and abundant debris, typical of reach 5, at km 83.7.

A section of reach 5 flowing through dense spruce forest at km 90.

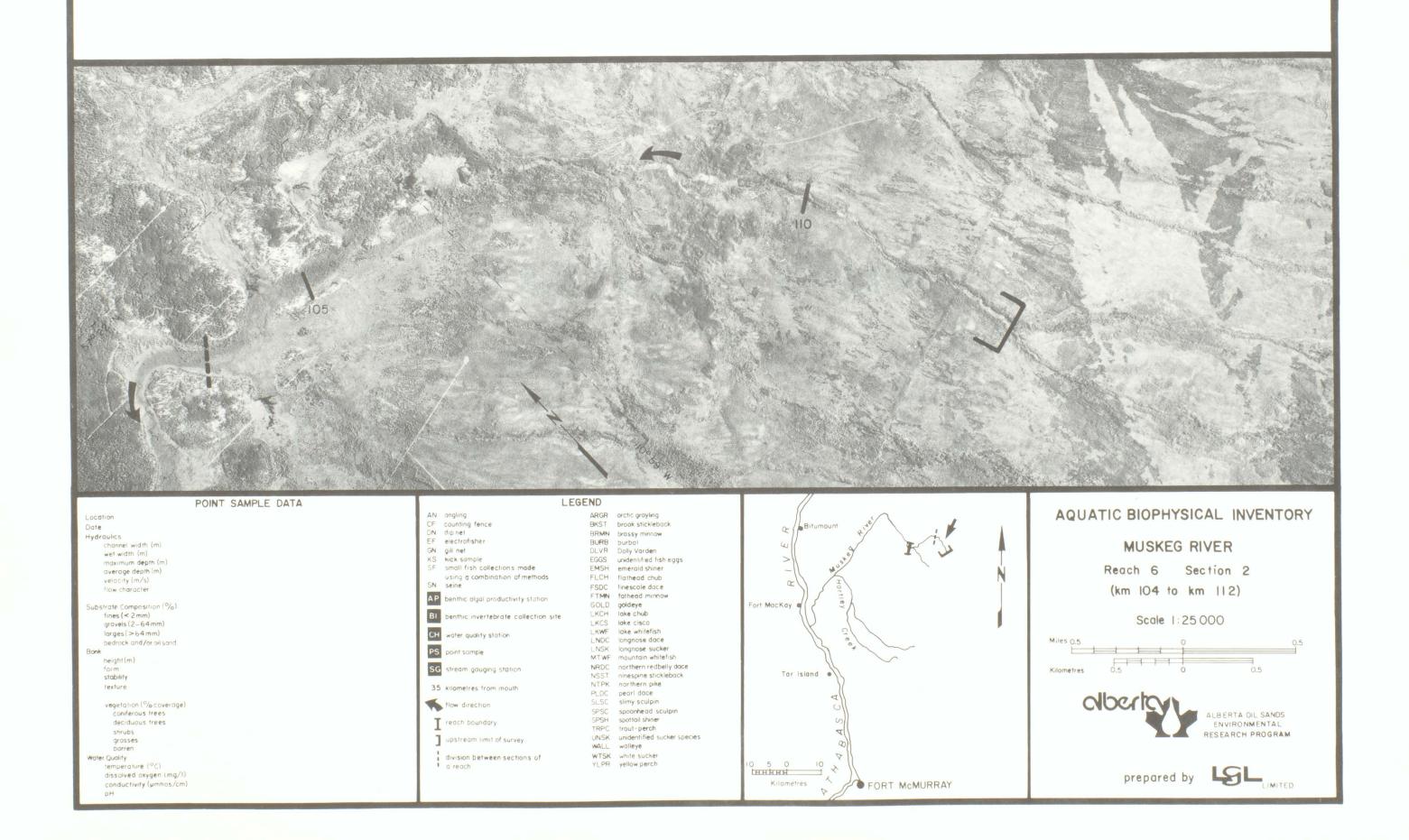


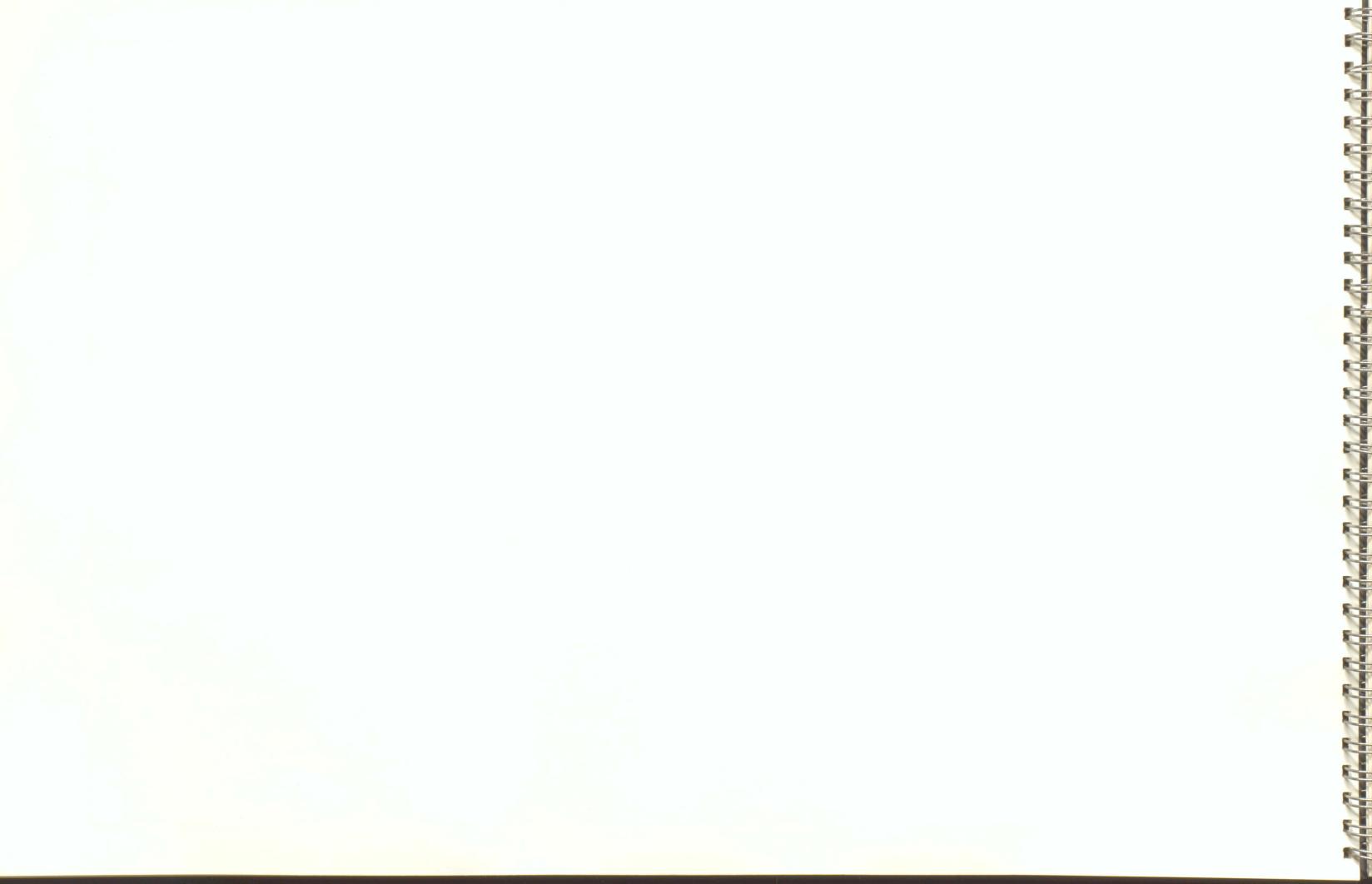
NUMBERS OF FISH COLLECTED (SEPTEM			Reach length (km) Channel width (m) Channel area (ha) Gradient (m/km) Flow character Total pools (%) Pattern Confinement Unstable banks (%) Substrate composition fines (<2 mm) gravels (2-64 mm) larges (>64 mm) bedrock and/or oil Debris	100 0 0	a very marshy region. that reduce the flow, pools. No sites were strate is probably sa vegetation consists of The stream channel is woody debris is abunc	the Muskeg River meanders in an irregular pattern through  Although the gradient is high, there are many beaver dams and the reach consequently consists entirely of placid esampled in this reach, but it is expected that the sub- and and silt with a high organic detritus content. Riparian of deciduous trees and shrubs and a dense growth of grasses. It is almost completely covered by overhanging vegetation, and dant. It is probable, however, that tole only for brook stickleback, which would be year-round
BENTHIC INVERTEBRATES  No benthic samples were taken in this reach.	Bank coverage (%) Coniferous trees 2 Deciduous trees 25 Shrubs 25 Grasses 90 Barren 0 Channel cover (%) Overhang 60 Crown 20	BENTHIC ALGAL PRODUCTIVITY  No data available for thi	is reach	STREAM GAUGING DATA  No data available for this rea	ach.	WATER QUALITY  No data available for this reach
						AQUATIC BIOPHYSICAL INVENTORY  MUSKEG RIVER  Reach 6 (km 93 to km II2)  ALBERTA OIL SANDS ENVIRONMENTAL RESEARCH PROGRAM  Prepared by

FISH COLLECTIONS

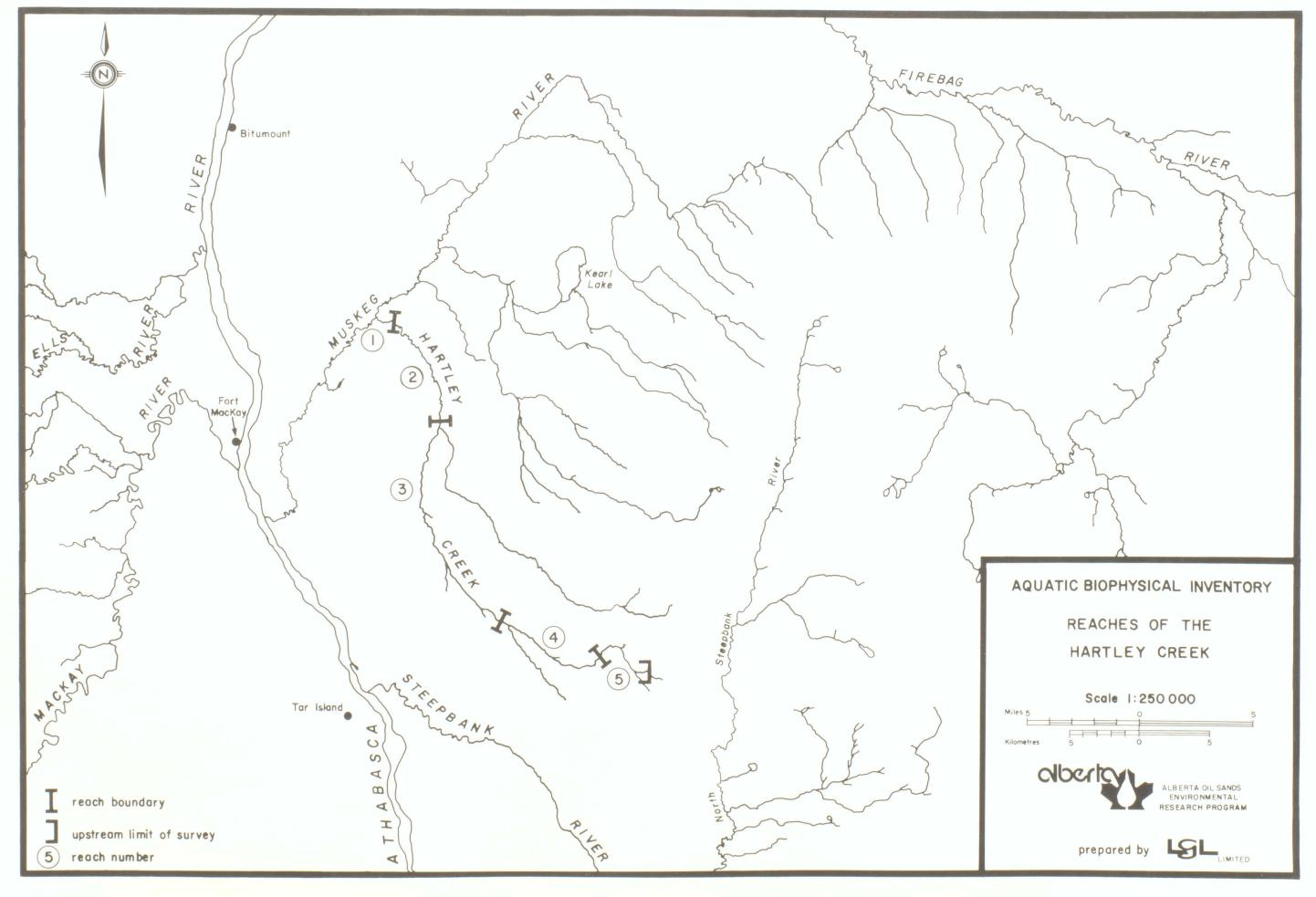


FISH COLLECTIONS





# HARTLEY CREEK



Species	Adults	Juveniles and Young-of-the-year	Total Numbers
brook stickleback	1	0	1
pearl dace	0	3	3
Total	1	3	4

#### PHYSICAL CHARACTERISTICS

Reach length (km)	4.5
Channel width (m)	9
Channel area (ha)	4.1
Gradient (m/km)	1.1
Flow character	placid, swirling
Total pools (%)	95
Pattern	tortuously meandering
Confinement	unconfined
Unstable banks (%)	0
Substrate composition (%)	
fines (<2 mm)	100
gravels (2-64 mm)	0
larges (>64 mm)	0
bedrock and/or oil sand	0
Debris	moderate

#### REACH DESCRIPTION AND FISH UTILIZATION

This short, tortuously meandering reach extends upstream 4.5 km from the confluence of Hartley Creek and the Muskeg River. The gradient is relatively low and the reach is almost entirely pools with placid or swirling flow. The substrate is entirely silt and sand with a low organic detritus content. The riparian vegetation consists of deciduous trees and shrubs and a dense growth of grasses. Substantial amounts of shrubs overhang the stream channel throughout this reach. There is a moderate amount of debris in the channel.

Weedy areas along the banks provide good spawning habitat for brook stickleback and northern pike. The spawning potential of this reach for other species is considered poor. Some areas with sand substrates may be suitable for spawning of pearl dace and lake chub. The low water velocities and the abundant debris. overhanging vegetation, and aquatic vegetation along the banks provide good rearing conditions in this reach. The water is moderately deep throughout the reach and appears to be sufficient for overwintering of fish.

## BENTHIC INVERTEBRATES

OLIGOCHAETA PELECYPODA INSECTA Ephemeroptera Hemiptera Corixidae Diptera Chironomidae Tanypodinae Orthocladiinae Tabanidae

Dolichopodidae

## RIPARIAN VEGETATION

Bank coverage (%) Coniferous trees Deciduous trees 75 Shrubs Grasses Barren Channel cover (%) Overhang Crown

#### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

#### TREAM GAUGING DATA

Water Survey of Canada station number 07DA009

Maximum total annual discharge:  $62.2 \times 10^6 \text{ m}^3$  (1978) Minimum total annual discharge: 20.1 x 10<sup>6</sup> m<sup>3</sup> (1977) Maximum annual mean discharge: 1.97 m<sup>3</sup>/s (1978) Minimum annual mean discharge: 0.63 m<sup>3</sup>/s (1977) Maximum monthly mean discharge: 9.20 m<sup>3</sup>/s (September 1978) Minimum monthly mean discharge:  $0.01 \text{ m}^3/\text{s}$  (February 1978) Maximum daily discharge:  $14.81 \text{ m}^3/\text{s}$  (July 20, 1975) 0.01 m<sup>3</sup>/s (Jan. 12, 1978) Minimum daily discharge:

Data for 1975 to 1978 compiled from Loeppky and Spitzer (1977) Warner and Spitzer (1979) and Warner (1979).

#### WATER QUALITY

Water Survey of Canada station number 00AT07DA0090

	Mean	Maximum	Minimum
Total alkalinity (mg CaCO <sub>3</sub> /1) pH	163.4 7.70	348.2 8.65	46.4
Total hardness (mg CaCO <sub>3</sub> /.)	140.0	317.0	43.1
Conductance (uS/cm)	292	660	100
Total filterable			
residue fixed (mg/1)	144	383	49
Total non-filterable residue fixed (mg/l)	15	400	<0.4
Total organic carbon (mg C/1)	28.0	96.0	9.0
Silica (mg SiO <sub>2</sub> /1)	8.8	16.8	1.7
Nitrate and nitrite nitrogen (mg N/1)	0.050	0.420	< 0.003
Total Kjeldahl nitrogen (mg N/1)	1.23	4.05	0.35
Total Phosphorus (mg P/1)	0.050	0.330	0.005
Orthophosphate (mg P/I)	0.010	0.060	0.004
Sulphate (mg SO <sub>4</sub> /1)	5.0	14.0	0.1

Data for the period January 1976 to December 1979 obtained from the National Water Quality Data Bank (NAQUADAT).

Hartley Creek at km 1.

Placid flow and abundant overhanging vegetation at km I are characteristic of this reach.

## AQUATIC BIOPHYSICAL INVENTORY HARTLEY CREEK

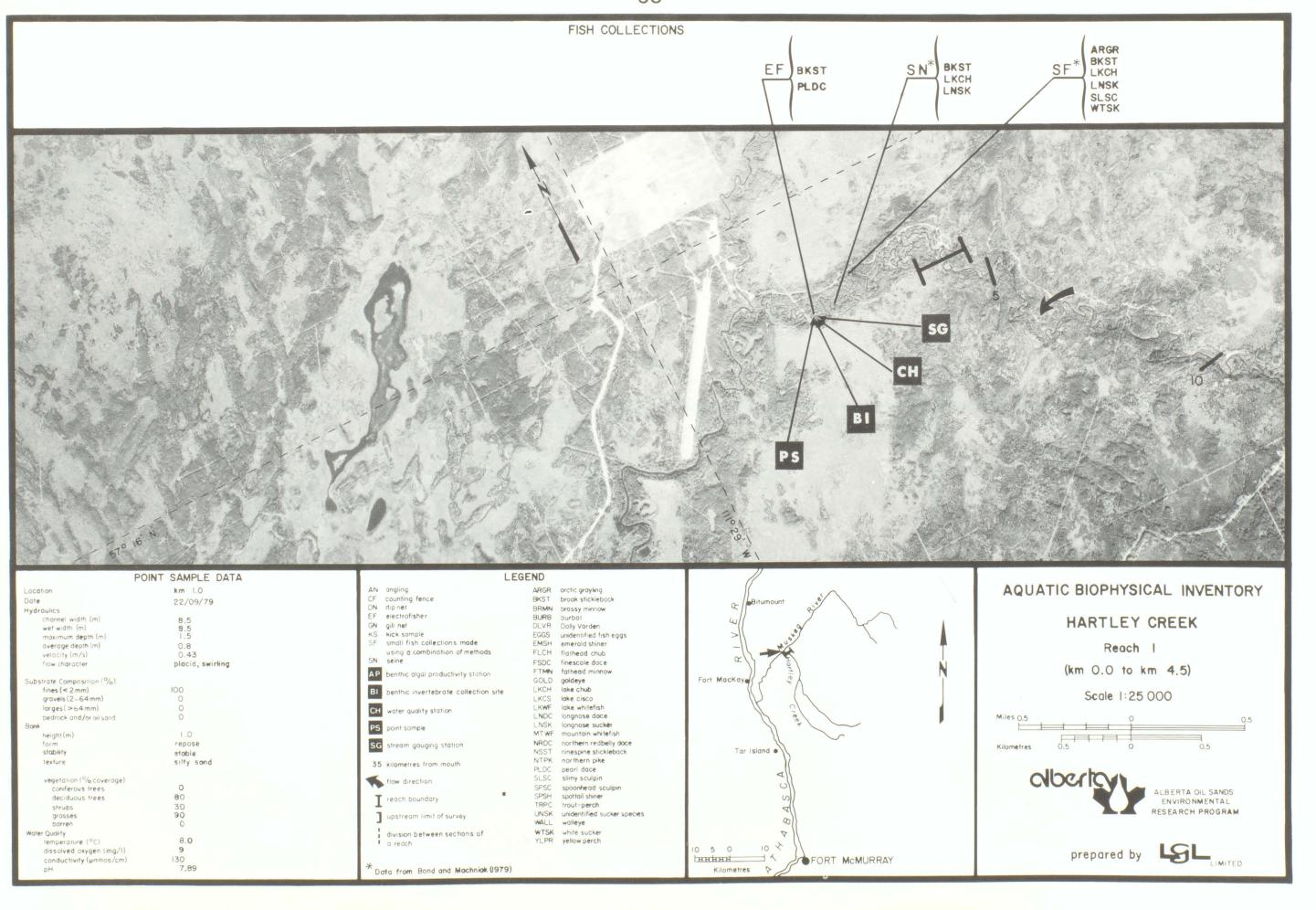
Reach I

(km 0.0 to km 4.5)



ALBERTA OIL SANDS ENVIRONMENTAL RESEARCH PROGRAM





Species	Adults	Juveniles and Young-of-the-year	Total	Numbers
arctic grayling	0	2		2
brook stickleback	3	1		4
slimy sculpin	0	3		3
white sucker	0	1		1
Total	3	7		10

RIPARIAN VEGETATION

Grasses Barren

Overhang

Crown

Bank coverage (%)

Channel cover (%)

Coniferous trees Deciduous trees Shrubs

15

#### PHYSICAL CHARACTERISTICS

Reach length (km)	16.5
Channel width (m)	10
Channel area (ha)	16.5
Gradient (m/km)	2.1
Flow character	placid, swirling, rolling
Total pools (%)	70
Pattern	irregularly meandering
Confinement	occasionally confined
Unstable banks (%)	0
Substrate composition (%)	
fines (<2 mm)	90
gravels (2-64 mm)	5
larges (>64 mm)	5
bedrock and/or oil sand	0
Debris	moderate

Placid pool at km 16.2.

#### REACH DESCRIPTION AND FISH UTILIZATION

This irregularly meandering section of Hartley Creek has a moderate gradient. Although the reach is mostly pools, riffle areas are fairly numerous. The flow character is mixed, varying from placid to swirling to rolling. There were several beaver dams present in this reach at the time the stream was surveyed in 1979. The substrate in most of the reach is sand with small amounts of silt; however, a number of areas (the riffle sections) do have gravelly and cobble substrates. Most quiet areas along the banks have some aquatic vegetation. The riparian vegetation is primarily deciduous trees and shrubs, but there are scattered patches of conifers. There is also a dense growth of grasses, and there is some overhanging vegetation throughout this reach. Moderate amounts of debris are present in the stream channel.

The sections of this reach with gravel and cobble substrates provide good spawning potential for a number of fish species (e.g., arctic grayling, longnose sucker, white sucker, longnose dace, slimy sculpin). The weedy shallow areas along the banks probably provide suitable spawning habitat for brook stickleback. The rearing potential of this reach is considered good because there are many areas with low water velocities and abundant shelter. The many deep pools in this reach are probably good for resting and feeding of larger fish. Water depths appear to be sufficient for overwintering of fish.

## BENTHIC INVERTEBRATES NEMATODA

OLIGOCHAETA GASTROPODA

PELECYPODA

ARACHNIDA Hydracarina INSECTA

Ephemeroptera Ameletus Drunella

Plecoptera

Isoperla Pteronarcys

Trichoptera

Cheumatopsyche Limnephilus

Coleoptera Dryopidae Elmidae

Tabanidae

Diptera Tipulidae Ceratopogonidae Chironomidae Chironominae Tanypodinae Orthocladiinae

#### A small riffle area at km 8.7.

#### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

#### STREAM GAUGING DATA

No data available for this reach

#### WATER QUALITY

Water Survey of Canada station number 00AT07DA0082

	mean	maximum	GTTT CHILD
Total alkalinity (mg CaCO <sub>3</sub> /1) pH Total hardness (mg CaCO <sub>3</sub> /1)	116.6	303.0 8.30 275.9	56.4 7.30 51.0
Conductance (µS/cm)	247	550	115
Total filterable			
residue fixed (mg/1)	125	346	50
Total non-filterable			
residue fixed (mg/1)	5	14	< 0.4
Total organic carbon (mg C/1)	25.0	41.0	12.0
Silica (mg SiO <sub>2</sub> /1)	7.8	17.0	1.8
Nitrate and nitrite nitrogen (mg N/1)	0.060	0.240	0.010
Total Kjeldahl nitrogen (mg N/1)	0.85	1.50	0.30
Total Phosphorus (mg P/1)	0.040	0.080	0.005
Orthophosphate (mg P/1)	0.010	0.011	0.005
Sulphate (mg SO <sub>4</sub> /1)	3.9	13.2	0.1

Data for the period January 1976 to December 1979 obtained from the National Water Quality Data Bank (NAQUADAT).

## AQUATIC BIOPHYSICAL INVENTORY HARTLEY CREEK

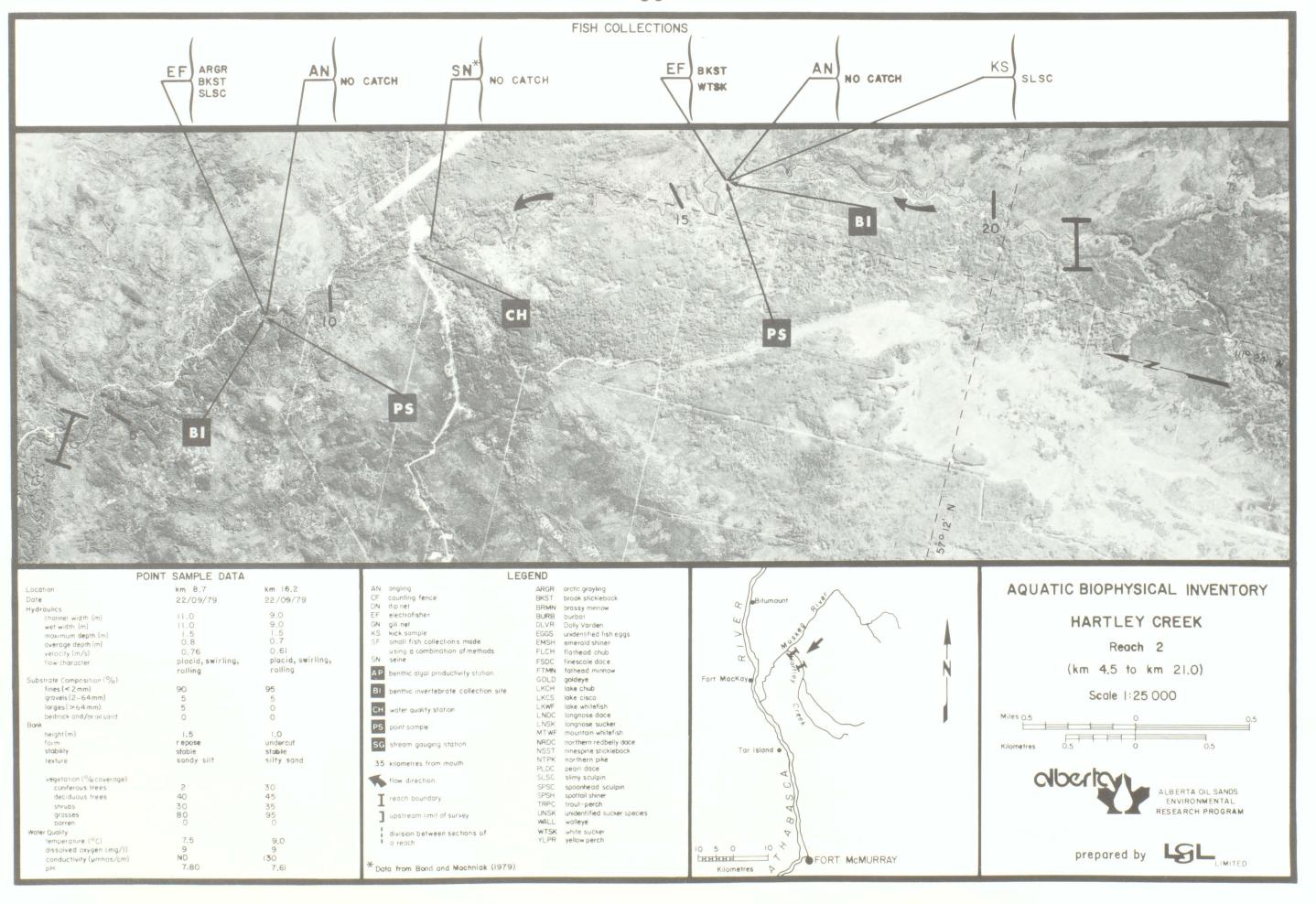
Reach 2

(km 4.5 to km 21.0)



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Species	Adults	Juveniles and Young-of-the-year	Total Numbers
pearl dace	0	3	3
	_	_	_
Total	0	3	3

RIPARIAN VEGETATION

Shrubs

Grasses

Barren

Overhang Crown

Bank coverage (%)

Channel cover (%)

Coniferous trees

Deciduous trees

15

20

95

#### PHYSICAL CHARACTERISTICS

Reach length (km)	28.0
Channel width (m)	7
Channel area (ha)	19.6
Gradient (m/km)	1.3
Flow character	placid, swirling
Total pools (%)	95
Pattern	tortuously meandering
Confinement	unconfined
Unstable banks (%)	0
Substrate composition (%)	
fines (<2 mm)	90
gravels (2-64 mm)	5
larges (>64 mm)	5
bedrock and/or oil sand	0
Debris	high

#### REACH DESCRIPTION AND FISH UTILIZATION

This section of Hartley Creek meanders in a tortuous pattern through a marshy area. The gradient is low and the flow is generally placid or swirling. A high proportion of the reach consists of pools, but there are some small riffle areas. Several beaver dams were present in this reach at the time the stream was surveyed in 1979. Although the substrate in most of the reach consists of sand and silt, there are a few areas with gravel and cobble substrates. The riparian vegetation is dominated by deciduous trees and shrubs and some areas of coniferous trees are present. There is a very dense growth of grasses, and the channel cover due to overhanging shrubs is fairly high. Large amounts of woody debris are present in the stream channel.

The spawning potential of this reach for those species that require gravel substrates is considered poor. The only suitable locations are the few small riffle areas. Many areas with sand substrates are probably suitable for spawning of pearl dace, and the abundant aquatic vegetation provides suitable spawning habitat for brook stickleback. The low water velocities, the aquatic vegetation, and the large amounts of debris provide many areas that appear suitable for rearing purposes. Water depths in this reach appear to be sufficient to allow overwintering of fish.

#### BENTHIC INVERTEBRATES

PELECYPODA ARACHNIDA Hydracarina CRUSTACEA Amphipoda

ammarus pseudolimn

INSECTA Ephemeroptera

Paraleptophlebia Odonata

Libellulidae Hemiptera Corixidae

Trichoptera Limnephilus/Philarctus

Coleoptera Gyrinidae Elmidae Diptera

Ceratopogonidae Chironomidae Chironominae Tanypodinae Tabanidae

#### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

#### STREAM GAUGING DATA

No data available for this reach

Water Survey of Canada station number 00AT07DA0095

	Mean	Maximum	Minimum
Total alkalinity (mg CaCO <sub>3</sub> /1) pH	163.0 7.50	307.0	70.0 7.00
Total hardness (mg CaCO <sub>3</sub> /1)	135.0	252.6	60.5
Conductance (µS/cm)	306	590	131
Total filterable			-
residue fixed (mg/1)	155	322	74
Total non-filterable			
residue fixed (mg/1)	15	46	< 0.4
Total organic carbon (mg C/1)	25.0	40.5	7.0
Silica (mg SiO <sub>2</sub> /1)	8.3	20.0	3.4
Nitrate and nitrite nitrogen (mg N/1)	0.01	0.01	0.006
Total Kjeldahl nitrogen (mg N/1)	1.42	4.17	0.10
Total Phosphorus (mg P/1)	0.110	0.500	0.014
Orthophosphate (mg P/1)	0.020	0.040	< 0.003
Sulphate (mg SO <sub>4</sub> /1)	5.3	10.8	0.6

Data for the period January 1976 to December 1979 obtained from the National Water Quality Data Bank (NAQUADAT).

## AQUATIC BIOPHYSICAL INVENTORY HARTLEY CREEK

Reach 3 (km 21 to km 49)



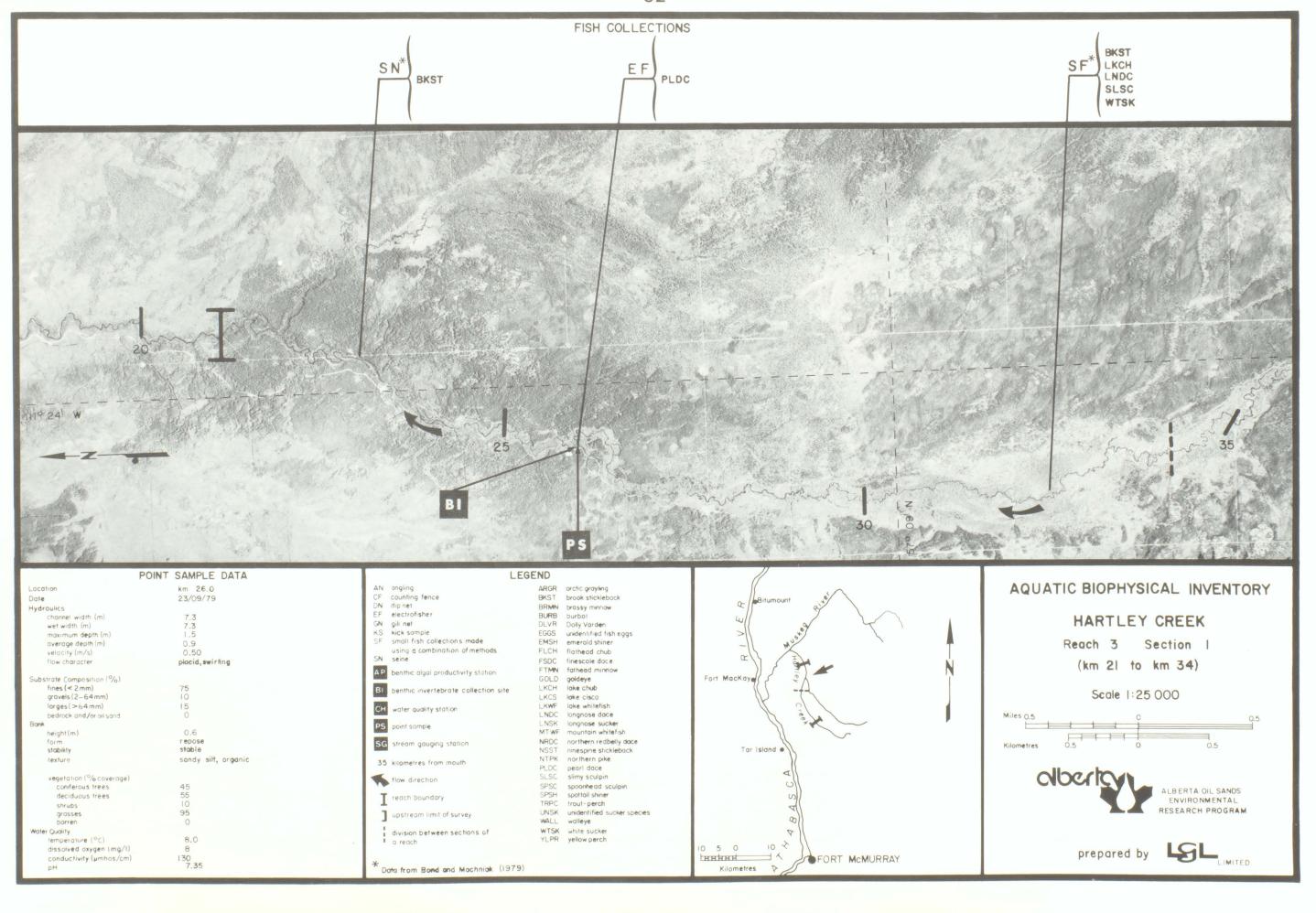
ALBERTA OIL SANDS ENVIRONMENTAL RESEARCH PROGRAM

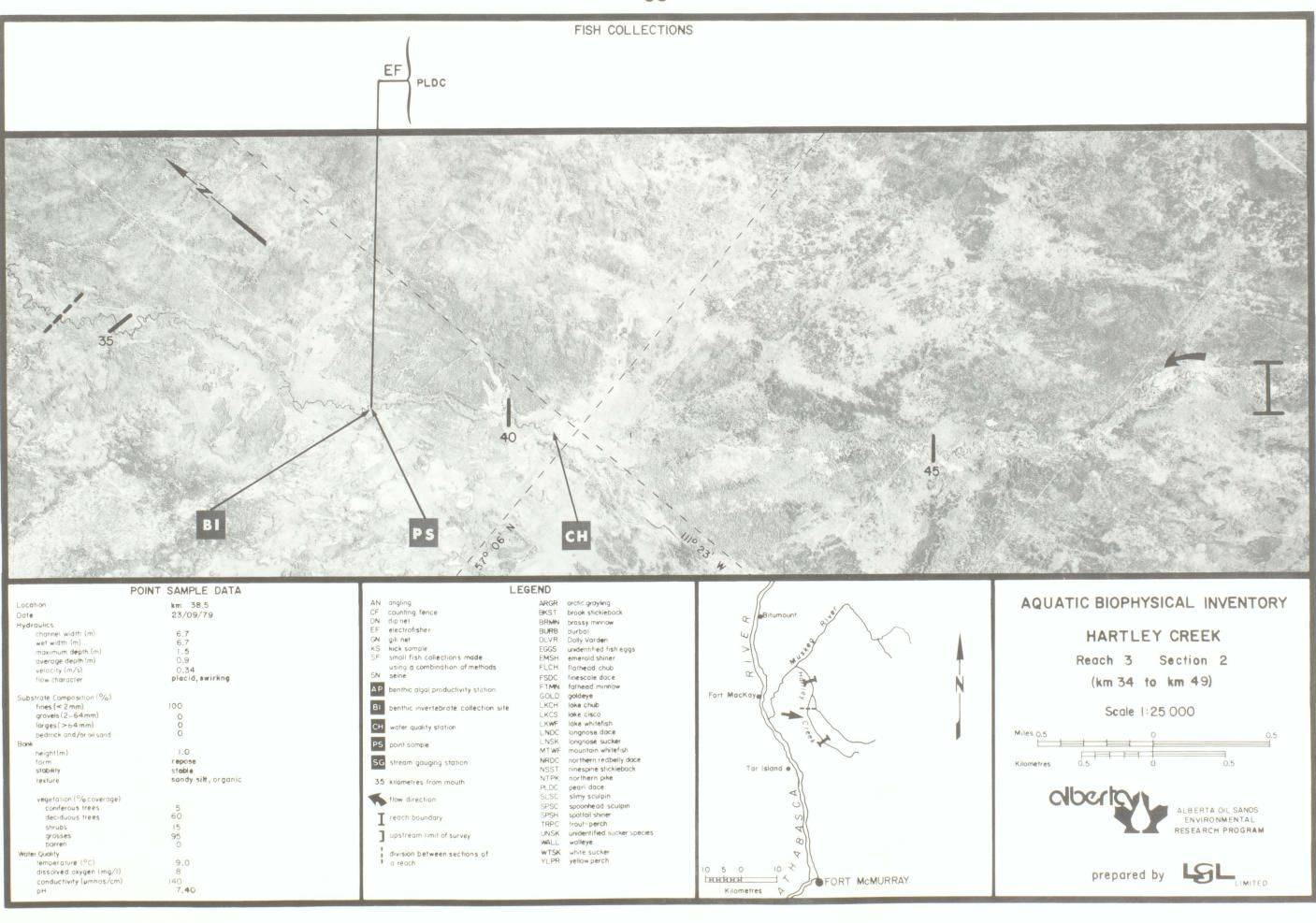




Hartley Creek at km 26.

Overhanging shrubs and heavily grassed banks at km 38.5.





Species	Adults	Juveniles and Young-of-the-year	Total Numbers
prook stickleback	6	4	10
white sucker	0	22	22
Total	6	26	32

#### PHYSICAL CHARACTERISTICS

Reach length (km)	12.5
Channel width (m)	20
Channel area (ha)	25.0
Gradient (m/km)	6.6
Flow character	placid, swirling, rolling
Total pools (%)	90
Pattern	irregularly meanderin
Confinement	occasionally confined
Unstable banks (%)	0
Substrate composition (%)	
fines (<2 mm)	95
gravels (2-64 mm)	5
larges (>64 mm)	0
bedrock and/or oil sand	0
Debris	high

#### REACH DESCRIPTION AND FISH UTILIZATION

This irregularly meandering section of Hartley Creek has a high gradient, and the flow character is mixed, varying from placid to swirling to rolling. Although the gradient is high, flow is impeded by the very many beaver dams, some of which are partially vegetated and appear to be very old. Because of the many beaver dams, the majority of the reach consists of pools. Some riffle areas are present immediately downstream from beaver dams. Substrates in most of the reach consist of silt and sand, but some gravel is present in the short riffle areas. The riparian vegetation is dominated by deciduous trees and shrubs in much of the reach, but coniferous trees are abundant in some areas. There are relatively small amounts of overhanging vegetation and large amounts of debris.

This reach is not considered to be suitable for spawning of most fish species; suitable substrates are extremely limited and the beaver dams severely limit movements of larger fish. There are many areas with abundant aquatic vegetation that are good spawning and rearing areas for brook stickleback. This species is undoubtedly a year-round resident in this reach.

#### BENTHIC INVERTEBRATES

HIRUDINEA Glossiphoniidae GASTROPODA CRUSTACEA

Amphipoda INSECTA

Ephemeroptera Odonata

Libellulidae Hemiptera Corixidae Megaloptera

Trichoptera

Coleoptera Haliplidae Dytiscidae Elmidae Diptera Tipulidae

Ceratopogonidae Chironomidae Chironominae Tanypodinae Orthocladiinae Tabanidae

#### RIPARIAN VEGETATION

Crown

Bank coverage (%) Coniferous trees Deciduous trees 40 Shrubs 25 Grasses Barren Channel cover (%) Overhang

#### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

#### STREAM GAUGING DATA

No data available for this reach

#### WATER QUALITY

No data available for this reach



Pond created by beaver dam at km 52.5.



Area of old beaver dam impoundment at km 61.

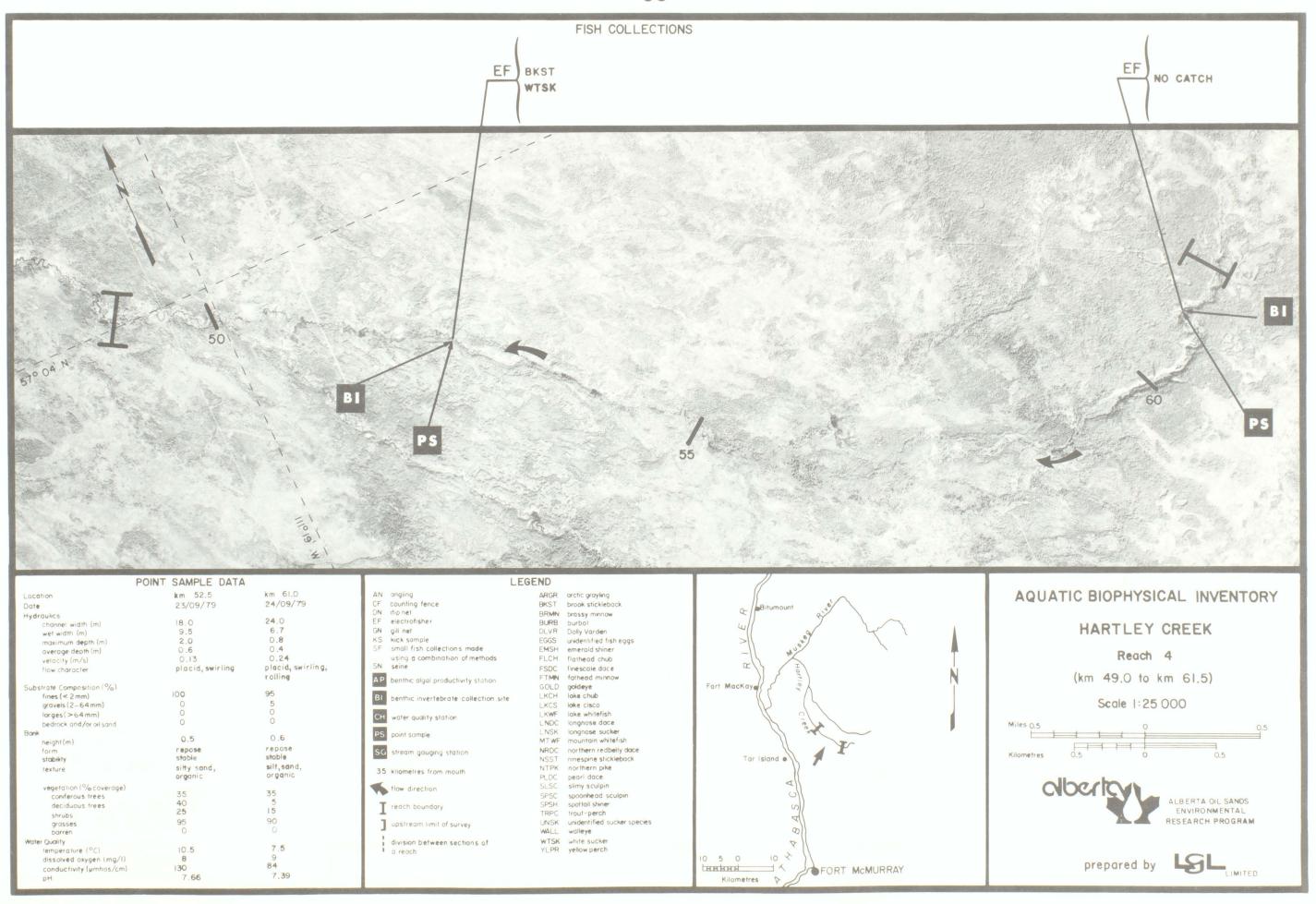
## AQUATIC BIOPHYSICAL INVENTORY HARTLEY CREEK

Reach 4

(km 49.0 to km 61.5)







No fish collections were made			Reach length (km) Channel width (m) Channel area (ha) Gradient (m/km) Flow character Total pools (%) Pattern Confinement Unstable banks (%) Substrate composition fines (<2 mm) gravels (2-64 mm) larges (>64 mm) bedrock and/or oil Debris	100 0 0	very marshy area. Al ous beaver dams and t of placid pools. Alt is believed to consis detritus content. Th deciduous trees, and grasses. A large pro and there is a large	Hartley Creek meanders in an irregular pattern through a lithough the gradient is high, water flow is impeded by numerather region is poorly drained. The reach consists entirely though no sites were sampled in this reach, the substrate st of sand and silt, and it probably has a high organic me riparian vegetation is a mixture of coniferous trees, deciduous shrubs. There is also a very dense growth of opportion of the stream is covered by overhanging vegetation amount of debris.
BENTHIC INVERTEBRATES  No benthic samples were taken in this reach.	RIPARIAN VEGETATION  Bank coverage (%) Coniferous trees 35 Deciduous trees 25 Shrubs 35 Grasses 95 Barren 0  Channel cover (%) Overhang 35 Crown 20	BENTHIC ALGAL PRODUCTIVITY  No data available for this	reach	STREAM GAUGING DATA  No data available for this rea	ach	WATER QUALITY  No data available for this reach
						AQUATIC BIOPHYSICAL INVENTORY HARTLEY CREEK Reach 5 (km 61.5 to km 69.0)  ALBERTA OIL SANDS ENVIRONMENTAL RESEARCH PROGRAM  Prepared by





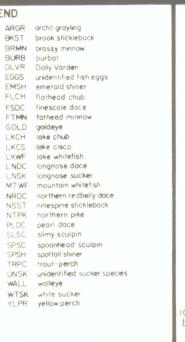
#### Date Hydraulics channel width (m) wet width (m) maximum depth (m) average depth (m) velocity (m/s) flow character Substrate Composition (%) fines (< 2 mm) gravels (2-64 mm) larges(>64mm) bedrock and/or oil sand height (m) stability texture vegetation (% coverage) coniferous trees deciduous trees shrubs grasses barren

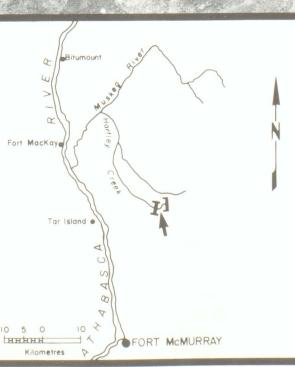
Water Quality

temperature (°C) dissolved oxygen (mg/l)

conductivity (pmhos/cm)

#### AN angling CF counting fence DN dip net EF electrofisher BKST brook stickleback BRMN brassy minnow BURB burbot DLVR Dolly Varden GN gill net KS kick sample SF small fish collections made EGGS unidentified fish eggs EMSH emerald shiner using a combination of methods SN seine FLCH flathead chub FSDC finescale dace AP benthic algal productivity station FTMN fathead minnow GOLD goldeye LKCH lake chub BI benthic invertebrate collection site LKCS lake cisco CH water quality station LKWF lake whitefish LNDC longnose dace PS point sample LNSK longnose sucker MTWF mountain whitefish SG stream gauging station NTPK northern pike 35 kilometres from mouth PLDC pearl dace SLSC slimy sculpin flow direction SPSC spoonhead sculpin SPSH spottail shiner TRPC trout-perch T reach boundary upstream limit of survey WALL walleye division between sections of a reach WTSK white sucker YLPR yellow perch





# AQUATIC BIOPHYSICAL INVENTORY

## HARTLEY CREEK

Reach 5 (km 61.5 to km 69.0)

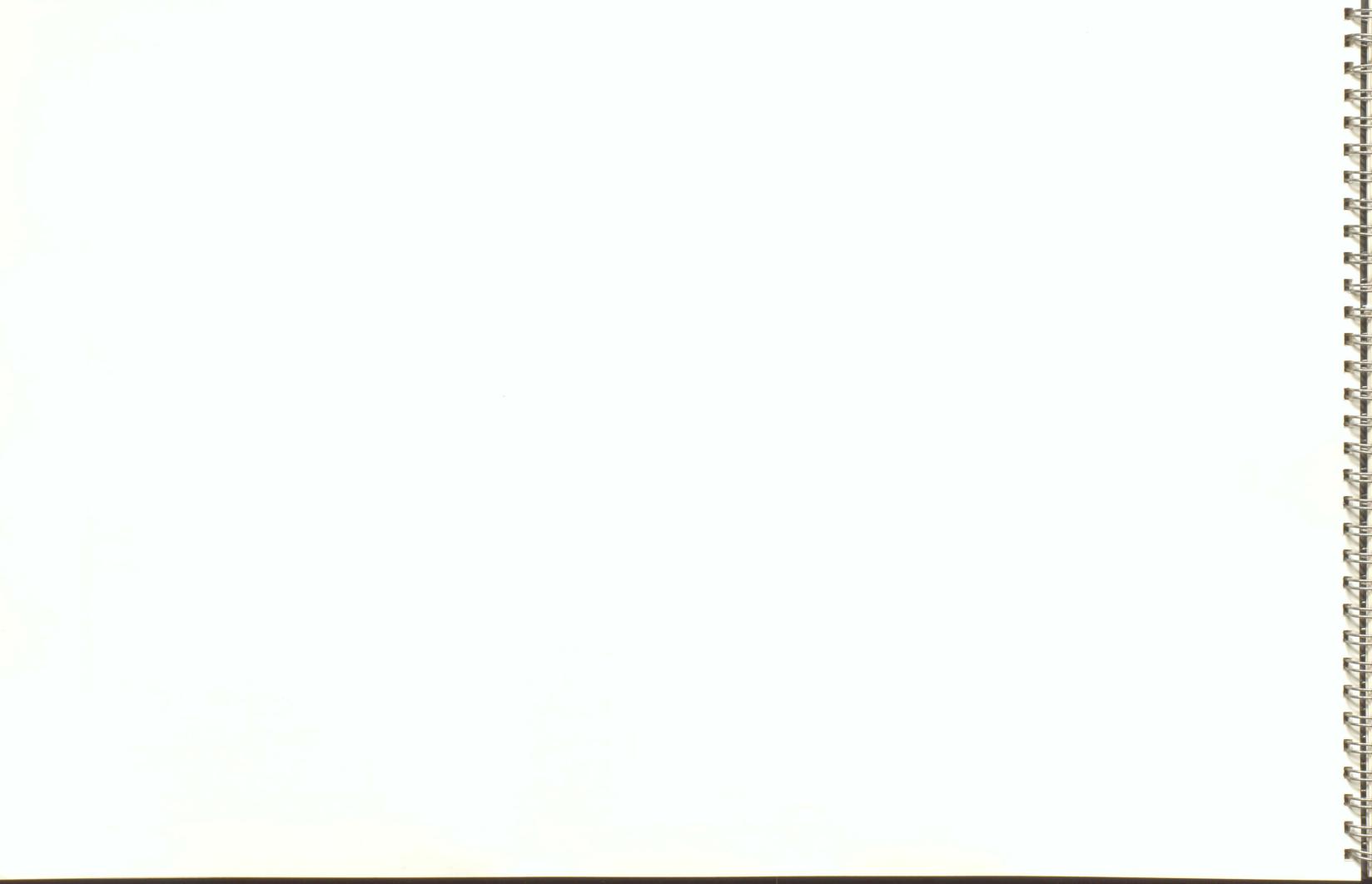
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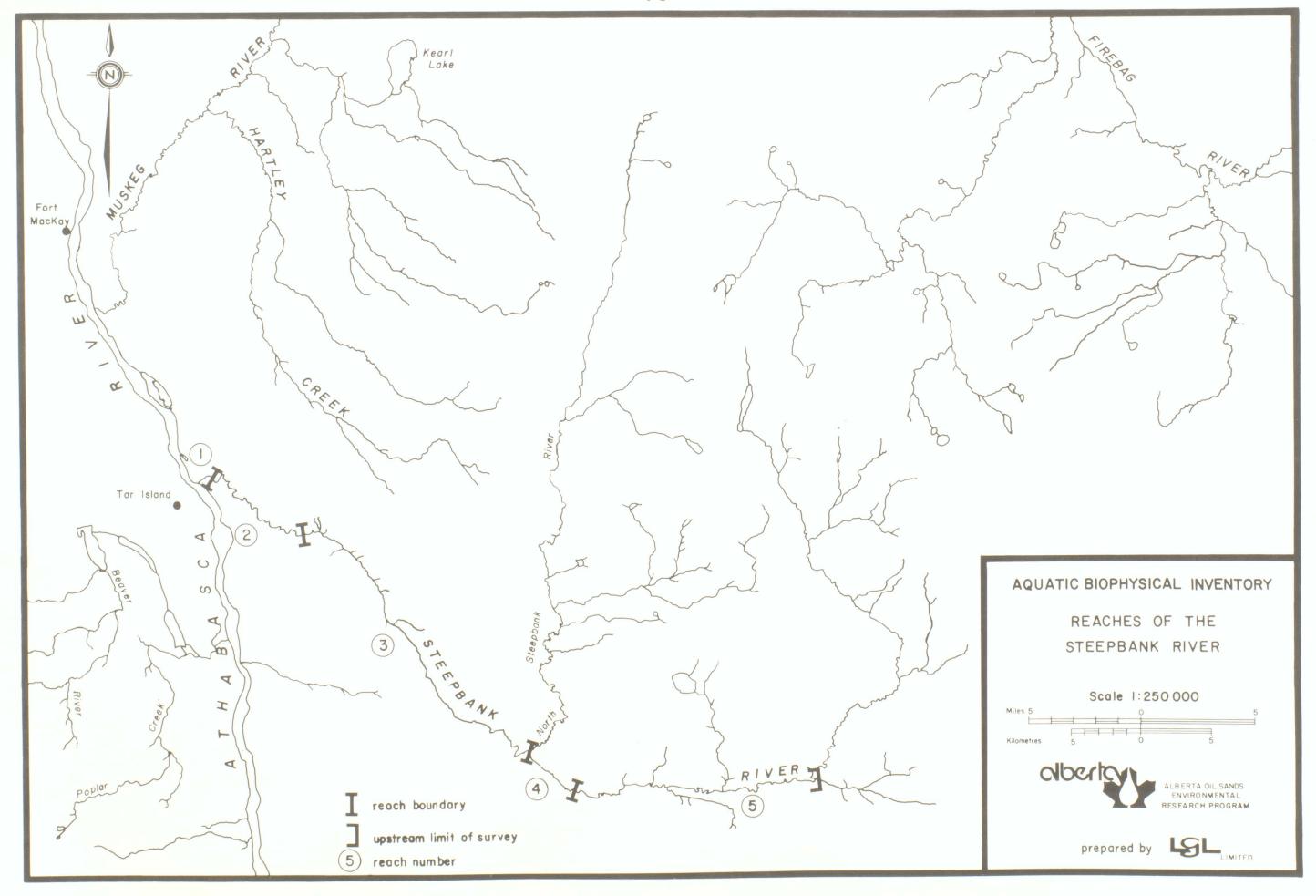


ALBERTA OIL SANDS ENVIRONMENTAL RESEARCH PROGRAM





# STEEPBANK RIVER



Species	Adults		Juveniles and Young-of-the-year		Total Numbers	
	June	September	June	September	June	September
arctic grayling	0	0	0	6	0	6
lake chub	1	0	0	7	0	8
longnose dace	1	0	4	3	5	3
longnose sucker	0	0	2	<i>L</i> <sub>4</sub>	2	4
mountain whitefish	0	0	0	<i>L</i> <sub>4</sub>	0	4
pearl dace	0	0	0	2	0	2
slimy sculpin	0	0	0	48	0	48
spoonhead sculpin	2	0	0	0	2	0
trout-perch	1	4	3	7	4	11
unidentified suckers	0	0	0	2	0	2
white sucker	0	0	0	2	0	2
Total	5	4	9	85	13	90

#### PHYSICAL CHARACTERISTICS

R	each length (km)	2.0
C	hannel width (m)	20
C	hannel area (ha)	4.0
G	radient (m/km)	2.7
F	low character	swirling, rolling
Т	otal pools (%)	50
P	attern	irregular
C	onfinement	occasionally confined
U	nstable banks (%)	10
S	ubstrate composition (%)	
	fines (<2 mm)	15
	gravels (2-64 mm)	50
	larges (>64 mm)	35
	bedrock and/or oil sand	0
D	ebris	low

#### REACH DESCRIPTION AND FISH UTILIZATION

This short, lower reach of the Steepbank River lies within the Athabasca River floodplain and is affected by water levels in that river. Gradient is relatively high and there are a few areas of unstable banks. Flow character is primarily swirling and rolling and about half of the total reach area is composed of pools. Gravels and larges are the dominant substrate materials. Riparian vegetation is dominated by deciduous trees but conifers are also fairly abundant. There is no vegetation overhanging the river channel.

Spawning potential for fish that normally spawn over rocky substrates is excellent and there are also some areas that are suitable for fish that normally spawn over sandy substrates. Adults of several forage fish species were captured in this reach during the study. Rearing potential is considered to be moderate; the most suitable rearing areas in the reach are the spaces between large stones and rocks. Young slimy sculpin were particularly abundant in September. The moderately deep water and numerous pools in the reach provide suitable resting, feeding and overwintering areas for larger fish. There are numerous forage species and young of larger species in this reach that would serve as prey for piscivores (e.g., northern pike, walleye).

#### BENTHIC INVERTEBRATES INSECTA

Ephemeroptera Baetis Rhithrogena

Odonata Plecoptera

> Chironominae Tanypodinae

Trichoptera Diptera Chironomidae

> Orthocladiinae Simuliidae Rhagionidae Empididae

### RIPARIAN VEGETATION

Bank coverage (%) Coniferous trees Deciduous trees Shrubs Grasses Barren Channel cover (%) Overhang Crown

#### BENTHIC ALGAL PRODUCTIVITY

Data from Hickman et al. (1980).

Standing crop expressed as cell counts (number·m<sup>-2</sup>) mean: maximum:  $2.6 \times 10^{10}$ minimum:  $1.9 \times 10^{10}$ Standing crop expressed as chlorophyll  $\alpha \pmod{-2}$ maximum: 229.8 minimum: 3.0 Primary productivity (mg C·h<sup>-1</sup>·m<sup>-2</sup>) mean: maximum: 19.3 minimum: 3.4

#### STREAM GAUGING DATA

No data available for this reach

#### WATER QUALITY

No data available for this reach



Confluence of the Steepbank River with the Athabasca River.



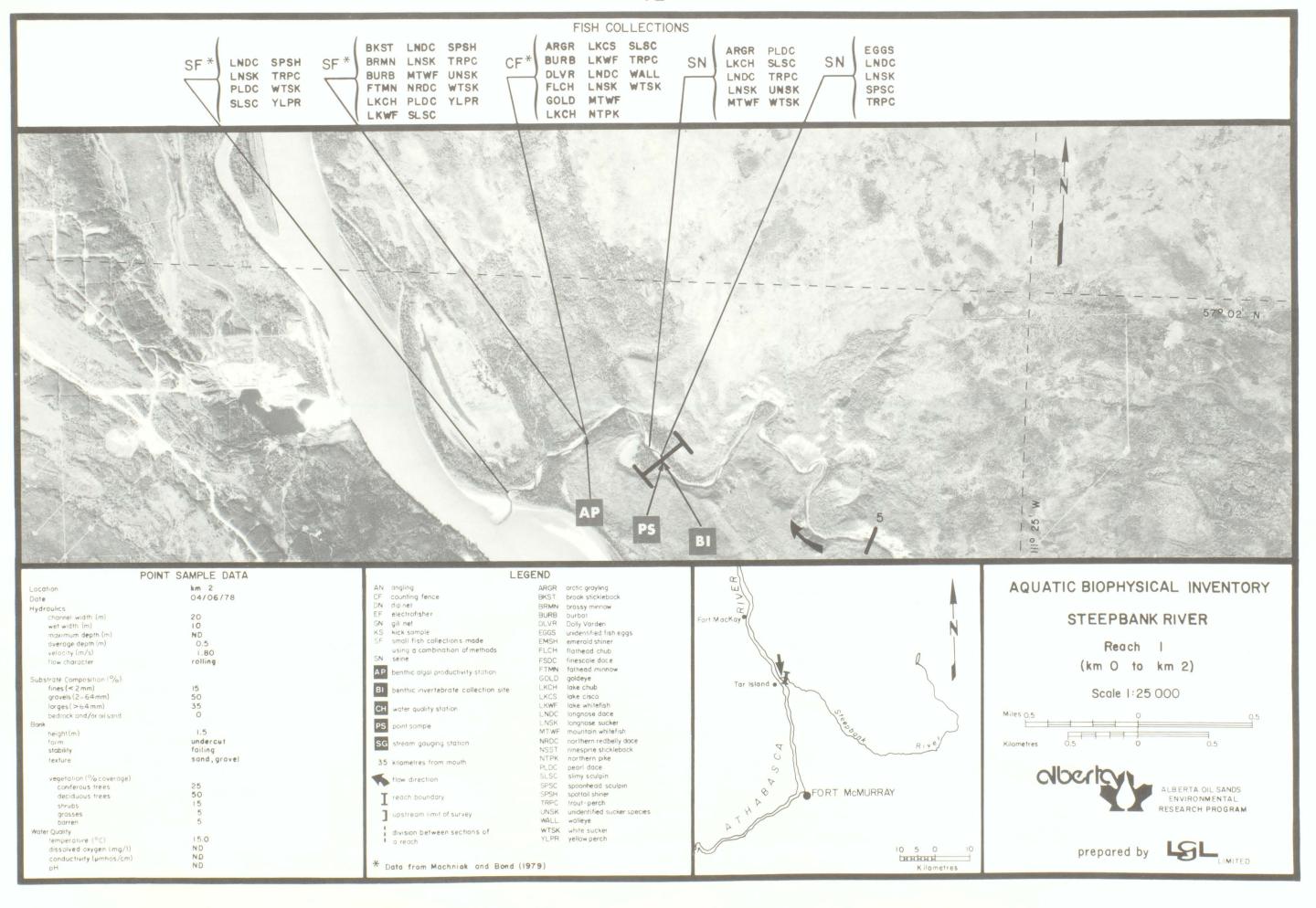
Undercut bank at km 2.

### AQUATIC BIOPHYSICAL INVENTORY STEEPBANK RIVER

Reach | (km 0 to km 2)







	Adults		Juveniles and Young-of-the-year		Total Numbers	
Species	June	September	June	September	June	September
arctic grayling	0	31	0	6	0	37
lake chub	0	0	0	6	0	6
longnose dace	0	0	0	2	0	2
longnose sucker	0	0	0	1	0	T
pearl dace	0	0	2	0	2	0
slimy sculpin	0	9	0	51	0	60
white sucker	0	2	0	0	0	2
Total	0	42	2	66	2	108

#### PHYSICAL CHARACTERISTICS

Reach length (km)	12	. 0
Channel width (m)	12	
Channel area (ha)	14	. 4
Gradient (m/km)	3	. 1
Flow character	rolling,	broken
Total pools (%)	50	
Pattern	irregularly	meandering
Confinement	entre	nched
Unstable banks (%)	20	
Substrate composition (%)		
fines (<2 mm)	15	
gravels (2-64 mm)	30	
larges (>64 mm)	40	
bedrock and/or oil sand	15	
Debris	10	N

#### REACH DESCRIPTION AND FISH UTILIZATION

This irregularly meandering section of the Steepbank River is confined within deep (up to 60 m) canyon walls of the McMurray Oil Sands formation, and areas of unstable banks are numerous. Although gradient and water velocities are relatively high, about half of the area of this reach is composed of pools. The substrate is composed primarily of larges and gravels. Riparian vegetation is dominated by deciduous trees, but conifers are also fairly abundant. There is no vegetation overhanging the channel.

Because of the diversity of substrate sizes and water velocities and depths, the spawning potential is considered to be excellent, particularly for those species that prefer to spawn over rocky substrates. A relatively high number of adult arctic grayling were captured in this reach. The potential for rearing purposes is considered to be moderate, with the large rocky substrates providing the major suitable areas. The most abundant young fish captured during the study were slimy sculpin. This reach is rated as good for resting and feeding of larger fish because the water is relatively deep and pools are numerous. For similar reasons, overwintering potential is considered to be good.

#### BENTHIC INVERTEBRATES

No benthic samples were taken in this reach.

#### RIPARIAN VEGETATION

Bank coverage (%) Coniferous trees 20 Deciduous trees 50 Shrubs Grasses Barren Channel cover (%) Overhang Crown

#### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

#### STREAM GAUGING DATA

Water Survey of Canada station number 07DA006

Maximum total annual discharge:  $331.8 \times 10^6 \text{ m}^3$  (1975) 95.8 x 10<sup>6</sup> m<sup>3</sup> (1977) Minimum total annual discharge: Maximum annual mean discharge: Minimum annual mean discharge: Maximum monthly mean discharge: 30.30 m3/s (September 1975 Minimum monthly mean discharge: 0.30 m<sup>3</sup>/s (December 1977 60.88 m<sup>3</sup>/s (Apr. 27, 1974) 0.25 m<sup>3</sup>/s (Dec. 18, 1977) Maximum daily discharge: Minimum daily discharge:

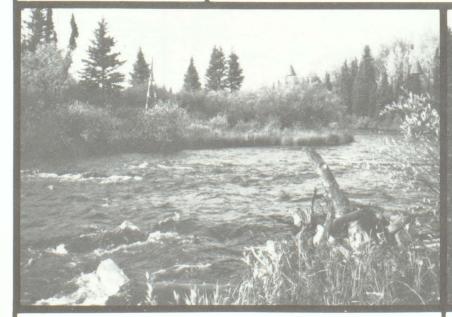
Data for 1972 to 1978 compiled from Loeppky and Spitzer (1977) Warner and Spitzer (1979) and Warner (1979).

#### WATER QUALITY

Water Survey of Canada station number 00AT07DA0060

	Mean	Maximum	Minimum
Total alkalinity (mg CaCO <sub>3</sub> /1) pH Total hardness (mg CaCO <sub>3</sub> /1) Conductance (µS/cm)	7.70 148.0 307	362.0 8.70 272.8 625	43.8 7.00 49.8 89
Total filterable residue fixed (mg/l) Total non-filterable	153	364	40
residue fixed (mg/l) Total organic carbon (mg C/l) Silica (mg SiO <sub>2</sub> /l) Nitrate and nitrite nitrogen (mg N/l) Total Kjeldahl nitrogen (mg N/l) Total Phosphorus (mg P/l)	17 20.0 8.0 0.110 1.00 0.060	0.220	<0.4 6.5 1.3 <0.003 0.36 0.016
Orthophosphate (mg P/1) Sulphate (mg SO <sub>4</sub> /1)	0.030	0.150	<0.003 1.9

Data for the period January 1976 to December 1979 obtained from the National Water Quality Data Bank (NAQUADAT).



Site of the Water Survey of Canada stream gauging station at km 8.



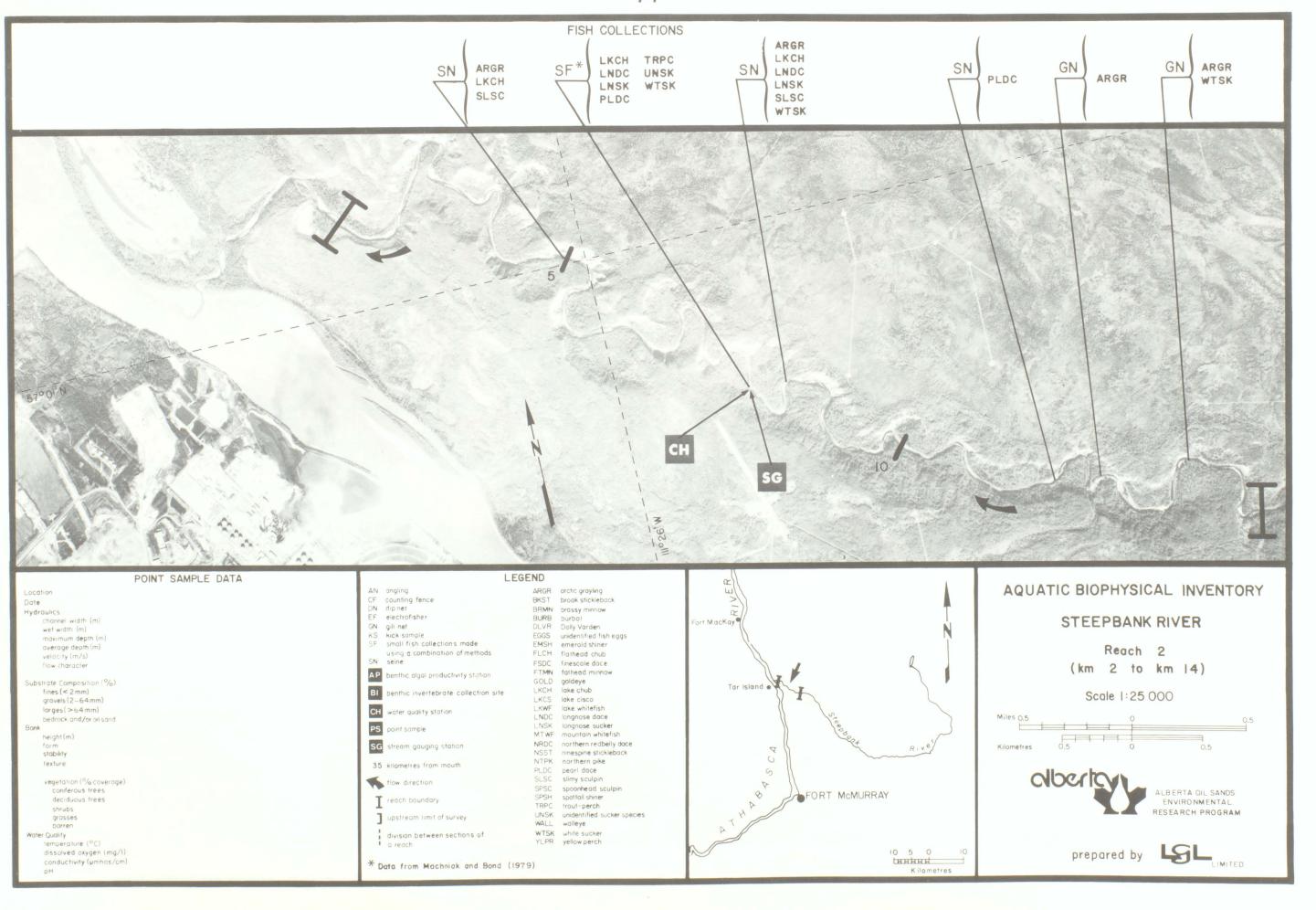
Steepbank River at km 12.

### AQUATIC BIOPHYSICAL INVENTORY STEEPBANK RIVER

Reach 2 (km 2 to km 14)







	Adults		Juveniles and Young-of-the-year		Tota	Total Numbers	
Species	June	September	June	September	June	September	
arctic grayling	2	0	2	2	4	2	
lake chub	0	14	8	22	8	26	
longnose dace	1	0	1.1	10	12	10	
longnose sucker	2	0	2	8	4	8	
pearl dace	0	0	6	11	6	11	
slimy sculpin	5	0	7	69	12	69	
trout-perch	0	0	11	7	11	7	
walleye	0	0	2	0	2	0	
white sucker	0	0	3	8	3	8	
Total	10	4	52	137	62	141	

#### PHYSICAL CHARACTERISTICS

Reach length (km)	28.0
Channel width (m)	12
Channel area (ha)	33.6
Gradient (m/km)	4.4
Flow character	swirling, rolling, broken
Total pools (%)	40
Pattern	sinuous
Confinement	confined
Unstable banks (%)	10
Substrate composition (%)	
fines (<2 mm)	15
gravels (2-64 mm)	45
larges (>64 mm)	40
bedrock and/or oil sand	0
Debris	low

#### REACH DESCRIPTION AND FISH UTILIZATION

This reach extends upstream from the near-vertical canyon walls of Reach 2 to the confluence of the Steepbank and North Steepbank rivers. This section flows in a sinuous pattern and the gradient is the highest recorded for the Steepbank River. Water velocity is generally high and flow character varies from swirling to rolling to broken. Pools compose a lower proportion of the reach than in other sections of the river. Substrates are composed primarily of gravels and larges. Coniferous trees are the dominant riparian vegetation and there is little vegetation overhanging the channel.

The diversity of substrate sizes, stream velocities, and water depths provides areas that should be excellent for spawning of most fish species found in the river, particularly those that require rocky substrates to spawn over. Arctic grayling adults netted here during this study were either developing or spent adults, and may have spawned in this reach. The grassy shallows present in this reach are excellent for spawning of northern pike and stickleback. Rearing potential for most fish is considered to be good because of the rocky substrates and grassy areas along the insides of bends where the water is shallow. Higher numbers of young fish were captured in the reach during this study than in other sections of the Steepbank River. The numbers of slimy sculpin were particularly high. Suitable areas for larger fish to rest and feed are found in the pools. Moderately deep waters and pools provide some overwintering potential for fish.

### BENTHIC INVERTEBRATES

INSECTA Ephemeroptera

Odonata

Plecoptera

Trichoptera

Ceraclea Cheumatopsyche Hydropsyche Micrasema Polycentropus

Diptera Tipulidae Psychodidae

> Ceratopogonidae Chironomidae Chironominae Tanypodinae Orthocladiinae Simuliidae

Tabanidae Rhagionidae Empididae

RIPARIAN VEGETATION

Bank coverage (%) 60 Coniferous trees Deciduous trees Grasses Barren Channel Cover (%) Overhang

BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

STREAM GAUGING DATA

No data available for this reach

#### WATER QUALITY

No data available for this reach



High, unstable sand and gravel bank at km 15.

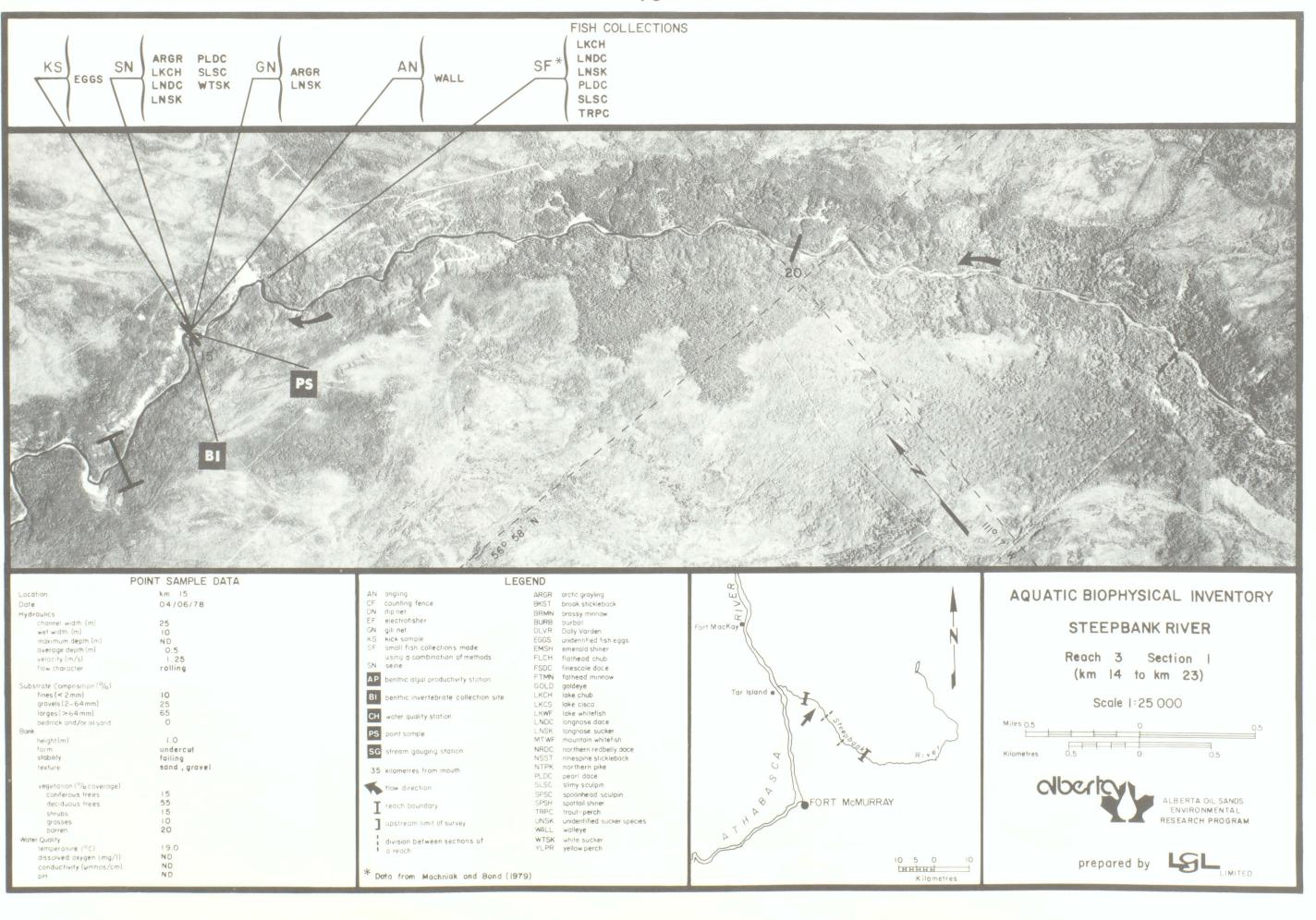
Section of riffles at km 30.

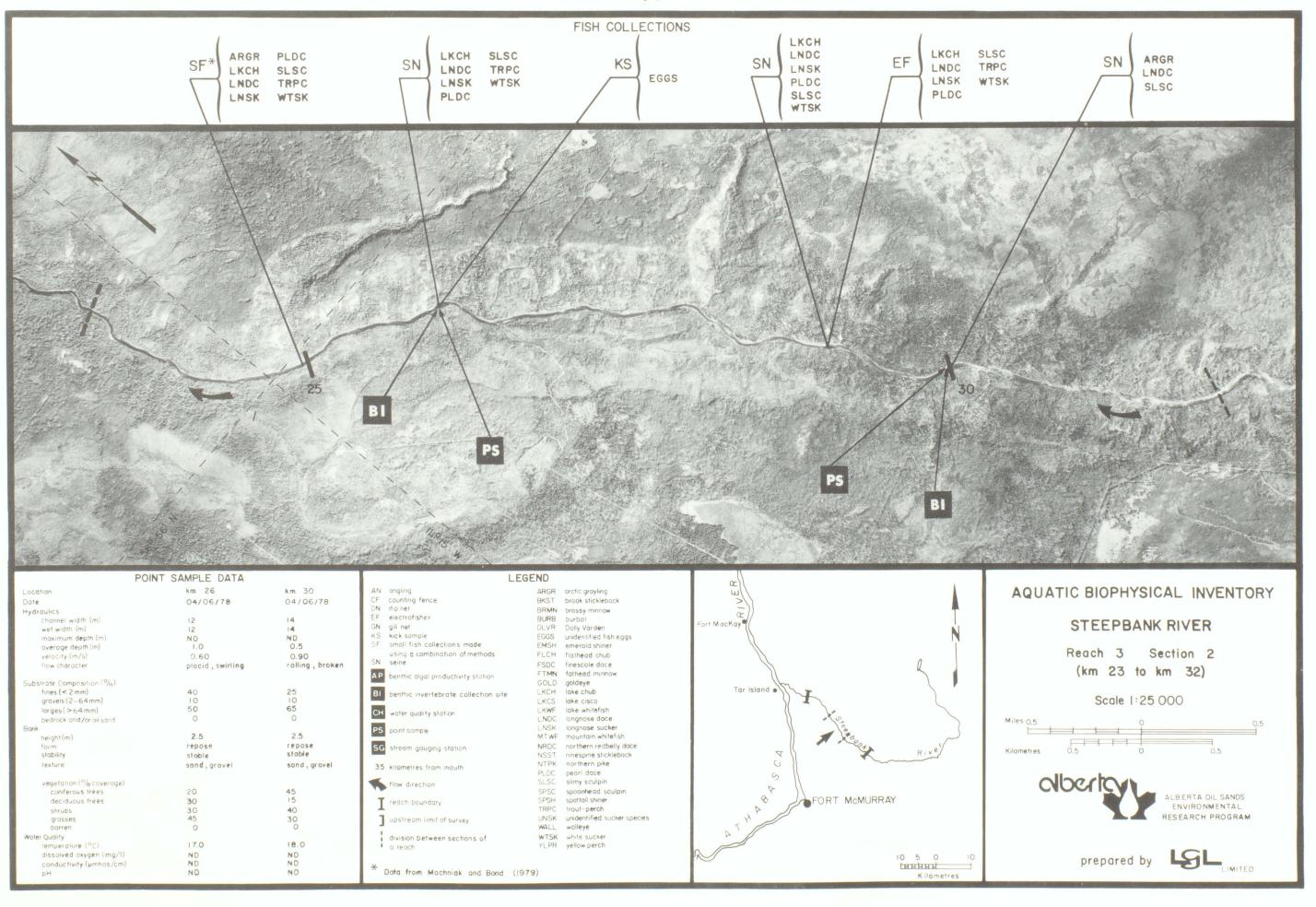
AQUATIC BIOPHYSICAL INVENTORY STEEPBANK RIVER

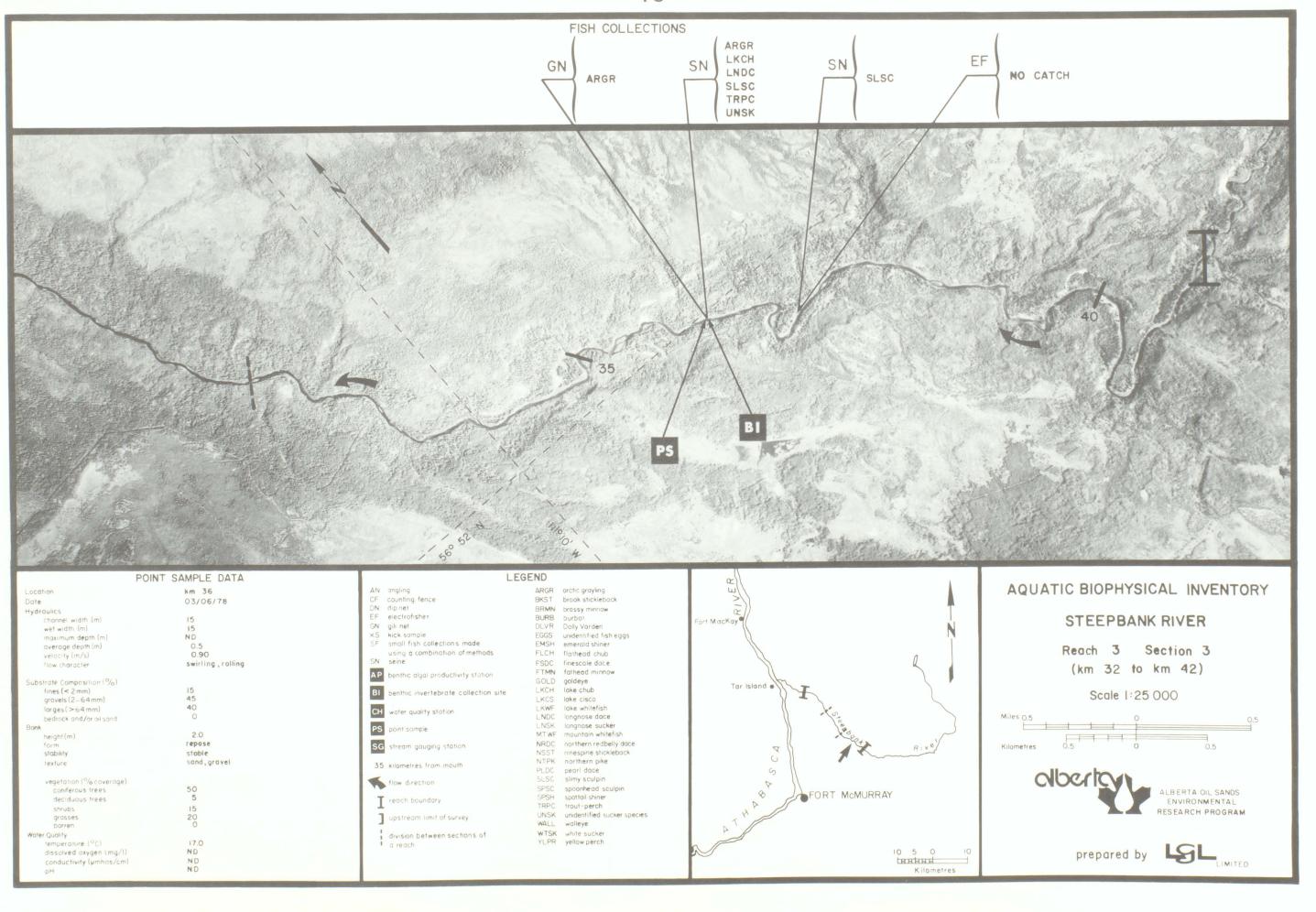
> Reach 3 (km 14 to km 42)











	Adults		Juveniles and Young-of-the-year		Total Numbers	
Species	June	September	June	September	June	September
arctic grayling	0	0	0	0	0	0
brook stickleback	0	0	0	1	0	1
longnose dace	2	0	0	1	2	1
pearl dace	0	0	2	0	2	0
slimy sculpin	2	1	3	17	5	18
unidentified fry	N/A	N/A	13	0	13	0
Total	4	1	18	19	22	20

#### PHYSICAL CHARACTERISTICS

Reach length (km)	5.0
Channel width (m)	10
Channel area (ha)	5.0
Gradient (m/km)	2.0
Flow character	swirling, rolling, broken
Total pools (%)	50
Pattern	sinuous
Confinement	confined
Unstable banks (%)	5
Substrate composition (%)	
fines (<2 mm)	20
gravels (2-64 mm)	20
larges (>64 mm)	60
bedrock and/or oil sand	0
Debris	low

#### REACH DESCRIPTION AND FISH UTILIZATION

velocities are moderate. Approximately half of the reach area consists of pools. The river banks are stable. The substrate consists mainly of larges with smaller amounts of both fines and gravels. The riparian vegetation consists of a dense growth of grasses and a mixture of deciduous shrubs, deciduous trees and coniferous trees. Little vegetation overhangs the channel.

Spawning potential in this reach is excellent for those fish that require rocky substrates. There are also numerous areas that are suitable for fish that normally spawn over sandy substrates. Suitable rearing areas for many fish are found in the rocky substrates (young-of-the-year fish) and the few areas sheltered by overhanging vegetation (juvenile fish). Pools provide the major suitable resting and feeding areas for larger fish. Although pools are numerous in this reach, they are not particularly deep; therefore, overwintering potential may be

## BENTHIC INVERTEBRATES PELECYPODA

INSECTA Ephemeroptera

Ephemerella

Odonata

Ophiogomphus Trichoptera

Cheumatopsyche Hydroptila Lepidostoma

Potamyia Diptera

Chironomidae

Empididae

Chironominae Tanypodinae Orthocladiinae Simuliidae Tabanidae Rhagionidae

#### RIPARIAN VEGETATION

Crown

Bank coverage (%) Coniferous trees Deciduous trees Shrubs Grasses Barren Channel cover (%) Overhang

#### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

#### STREAM GAUGING DATA

No data available for this reach

#### WATER QUALITY

No data available for this reach



Aerial view of reach 4, looking downstream from about km 44.

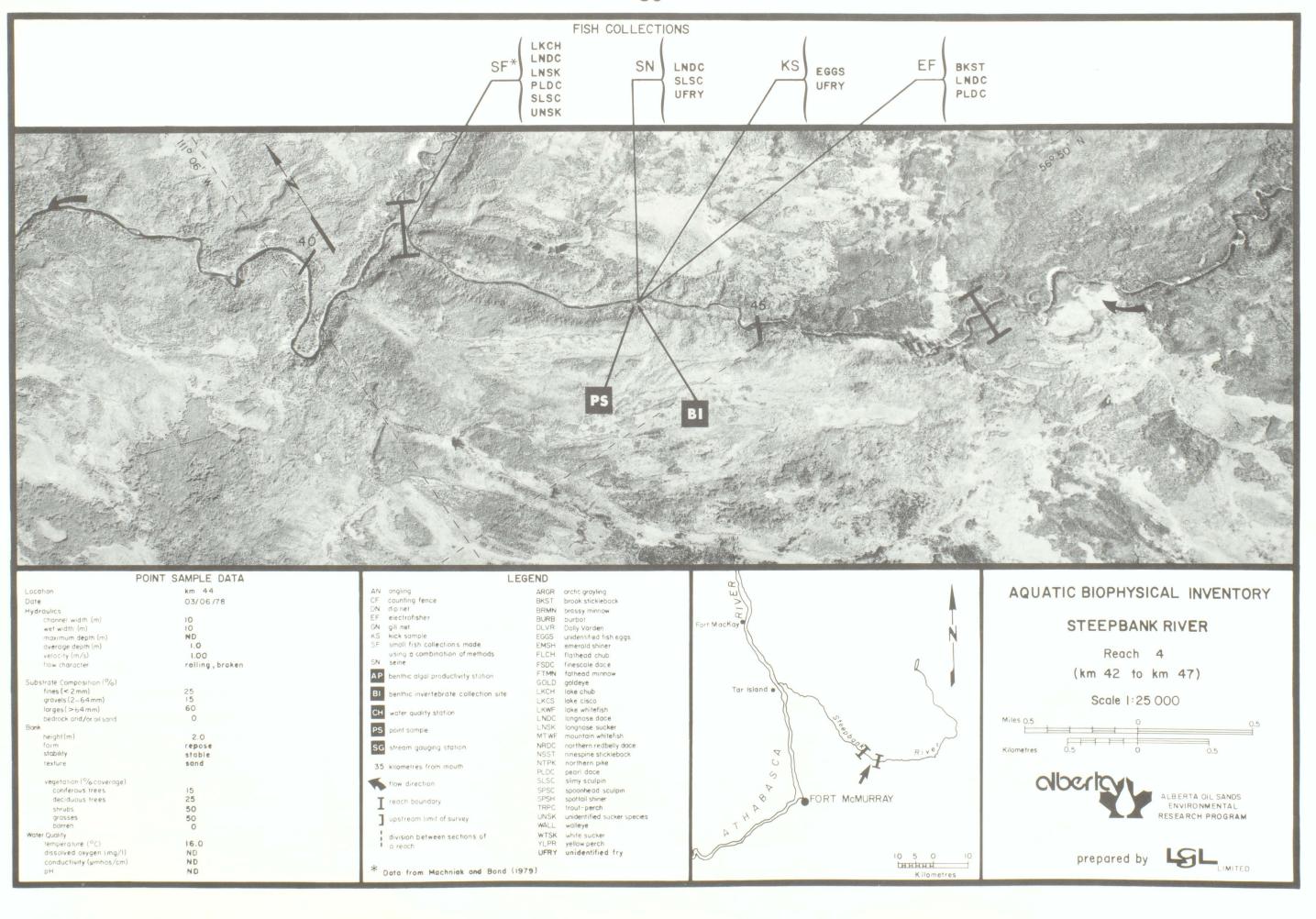
Riffle area with large substrate material at km 46.

### AQUATIC BIOPHYSICAL INVENTORY STEEPBANK RIVER

Reach 4 (km 42 to km 47)







	Adults		Juveniles and Young-of-the-year		Total Numbers	
Species	June	September	June	September	June	September
arctic grayling	0	0	0	0	0	0
brook stickleback	0	0	0	1	0	1
lake chub	0	0	4	1	4	1
longnose sucker	0	0	1	3	1	3
pearl dace	0	18	27	21	27	39
slimy sculpin	1	5	3	3	4	8
trout-perch	0	3	5	4	5	7
unidentified suckers	0	0	0	3	0	3
white sucker	0	0	2	2	2	2
Total	1	26	42	38	43	64

#### PHYSICAL CHARACTERISTICS

Reach length (km)	28.0
Channel width (m)	12
Channel area (ha)	33.6
Gradient (m/km)	1.3
Flow character	placid
Total pools (%)	90
Pattern	irregularly meandering
Confinement	occasionally confined
Unstable banks (%)	5
Substrate composition (%)	
fines (<2 mm)	90
gravels (2-64 mm)	10
larges (>64 mm)	0
bedrock and/or oil sand	0
Debris	high

#### REACH DESCRIPTION AND FISH UTILIZATION

This section of the Steepbank River is essentially a narrow, irregularly meandering pool with relatively placid waters. Both gradient and water velocities are the lowest recorded for the river, and water depths are somewhat greater than in other sections of the river. The river banks in this reach are stable. The substrate is almost entirely fines, with a very low proportion of gravels. Large amounts of debris and frequent log obstructions exist in the reach. Deciduous trees and shrubs are more abundant in the riparian vegetation than are conifers and grasses are very abundant. There is a moderate amount of overhanging vegetation.

Spawning potential for those fish that will spawn over sandy substrates (e.g., several minnows, trout-perch, coregonids, and goldeye) is good in this reach. Waters are probably sufficiently deep to allow burbot spawning in the winter under the ice (this species will spawn over sandy substrates). Grassy shallows in this reach are suitable for spawning of northern pike and stickleback. Because of the slow water velocities, grassy shallows, and the abundance of sheltered areas provided by debris, logs, and overhanging vegetation, the rearing potential for many fish is considered to be excellent. The many pools and areas sheltered by overhanging vegetation, debris, and logs provide excellent resting and feeding areas for larger fish. Overwintering potential is good due to the generally deep waters and numerous pools.

### BENTHIC INVERTEBRATES

GASTROPODA

PELECYPODA

INSECTA Ephemeroptera

Baetis Caenis Stenonema

Plecoptera Hemiptera Corixidae Trichoptera

Brachycentrus Homophylax

Oxyethira Diptera Tipulidae Chironomidae Chironominae Tanypodinae Orthocladiinae Tabanidae Empididae

#### RIPARIAN VEGETATION

Bank coverage (%) Coniferous trees Deciduous trees Shrubs Grasses Barren Channel cover (%) Overhang

#### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

#### STREAM GAUGING DATA

No data available for this reach

#### WATER QUALITY

No data available for this reach



Placid, slow-moving pool at km 60.



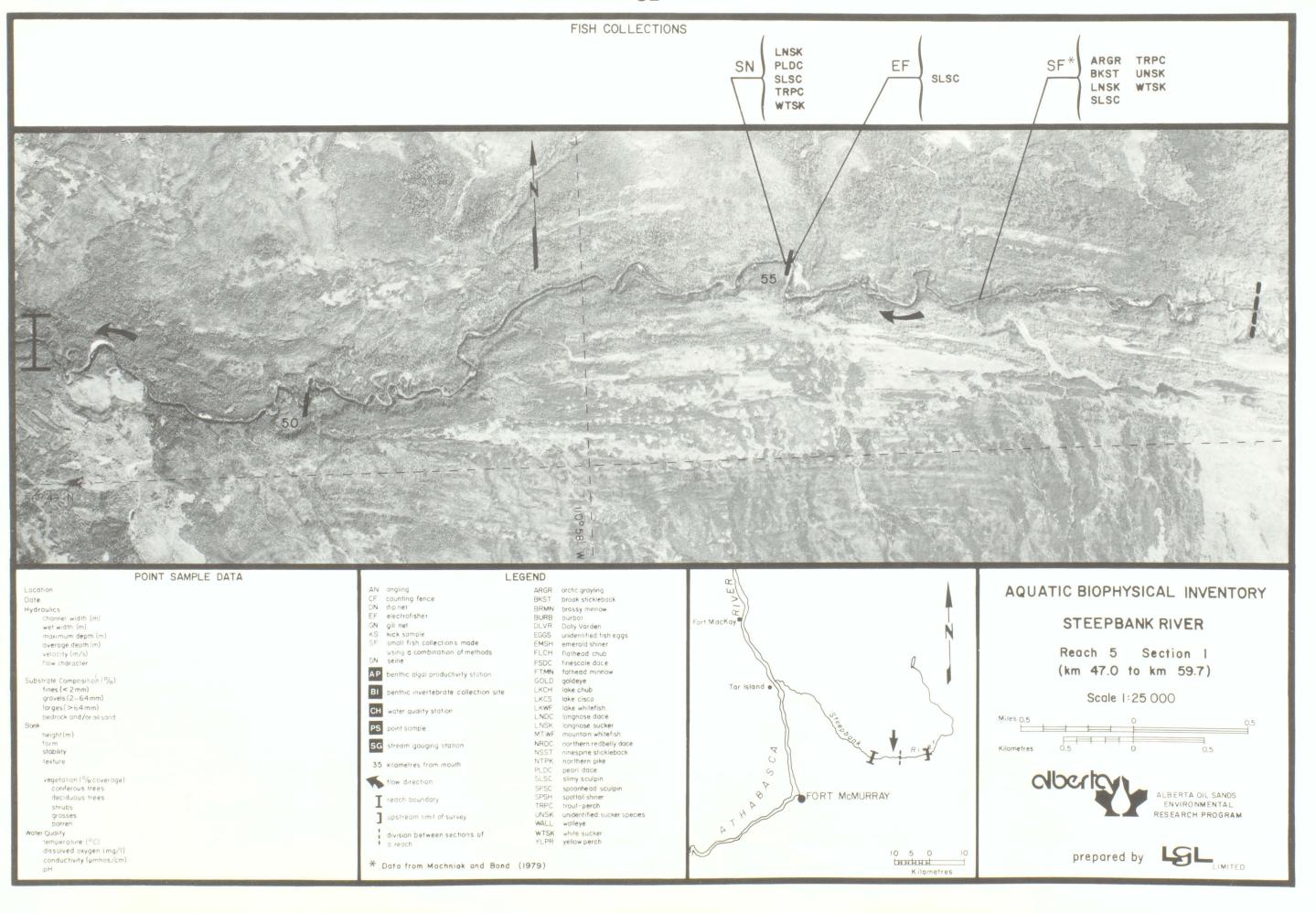
A typical section of reach 5 at km 75.

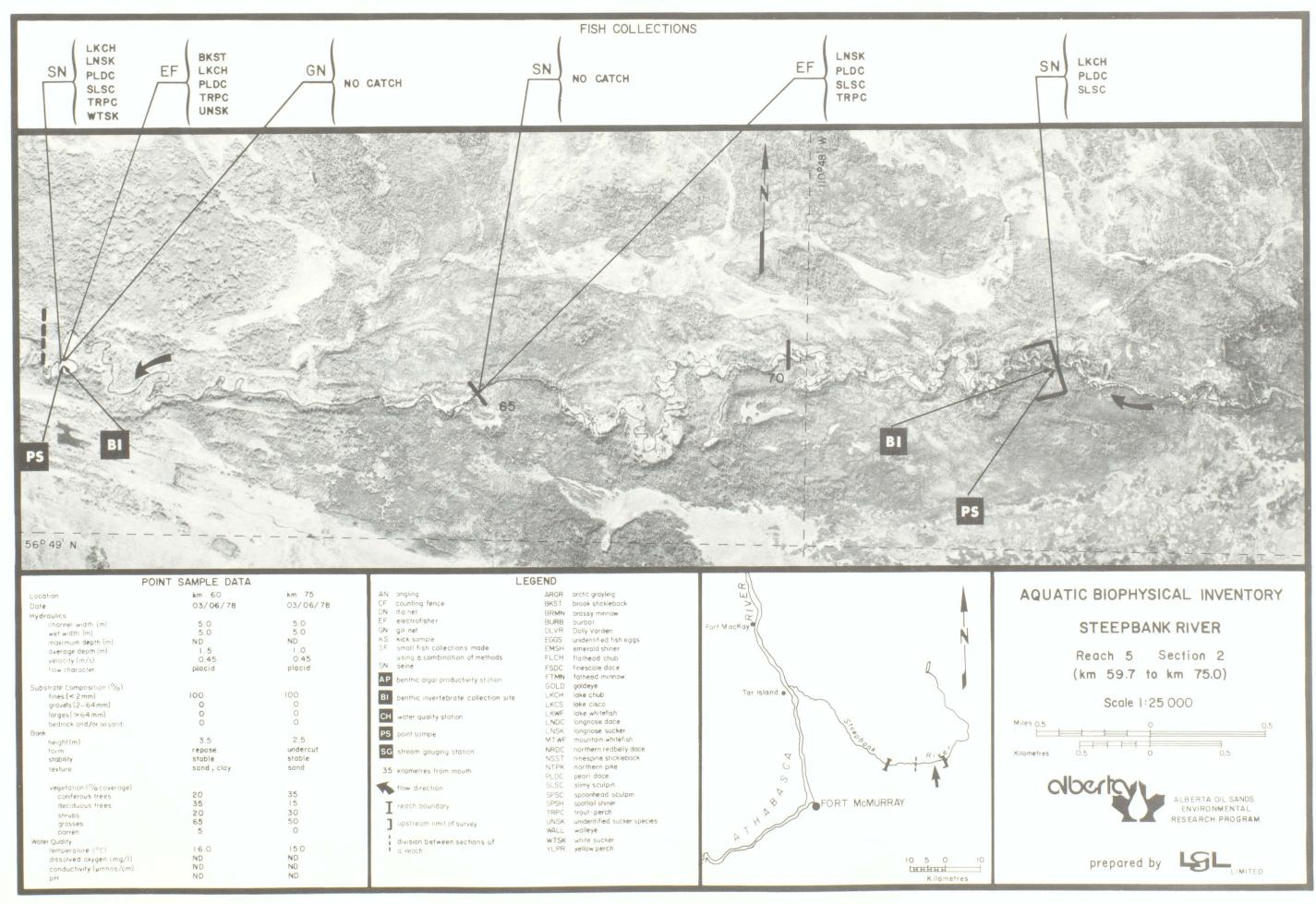
### AQUATIC BIOPHYSICAL INVENTORY STEEPBANK RIVER

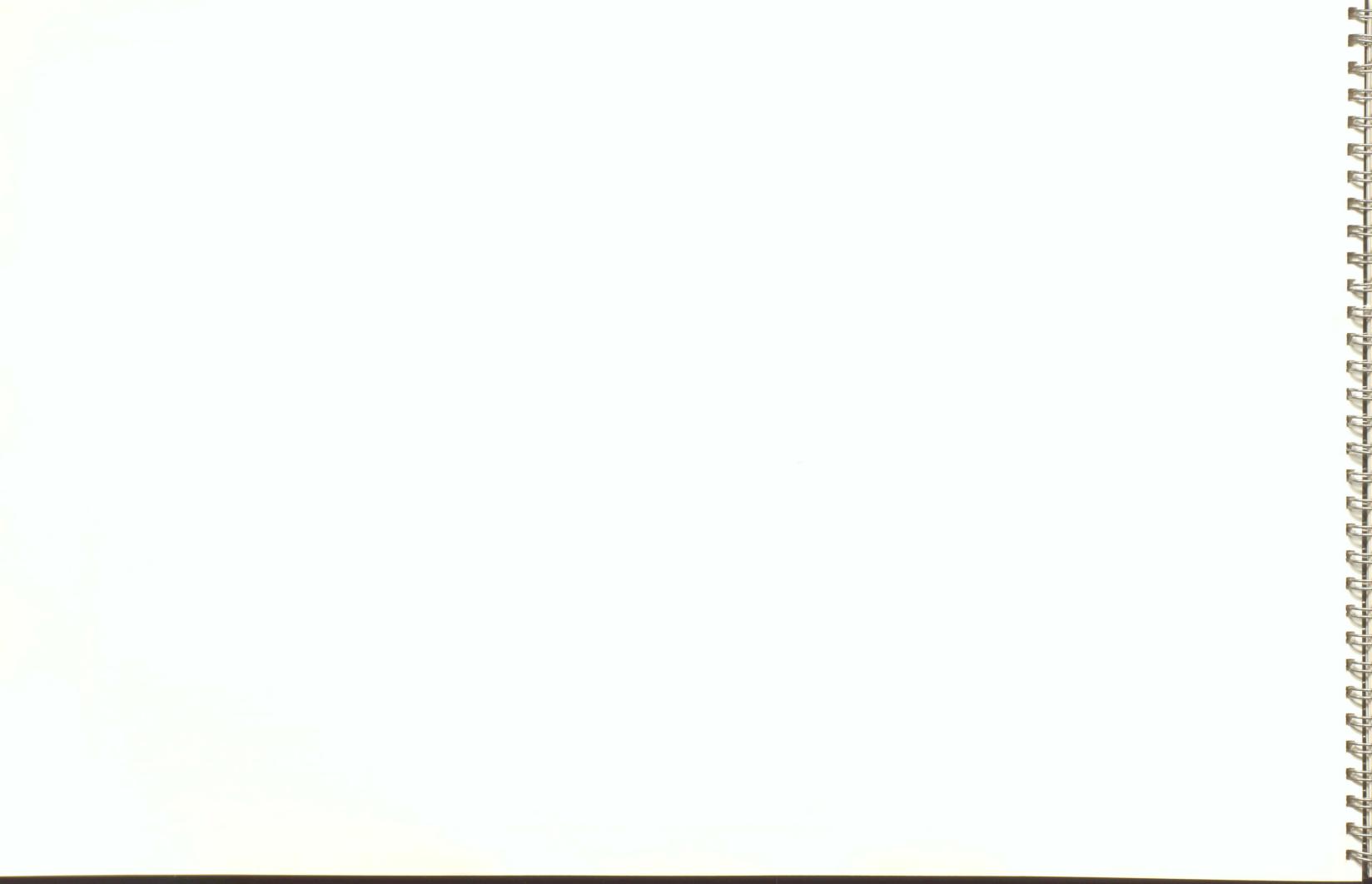
Reach 5 (km 47 to km 75)



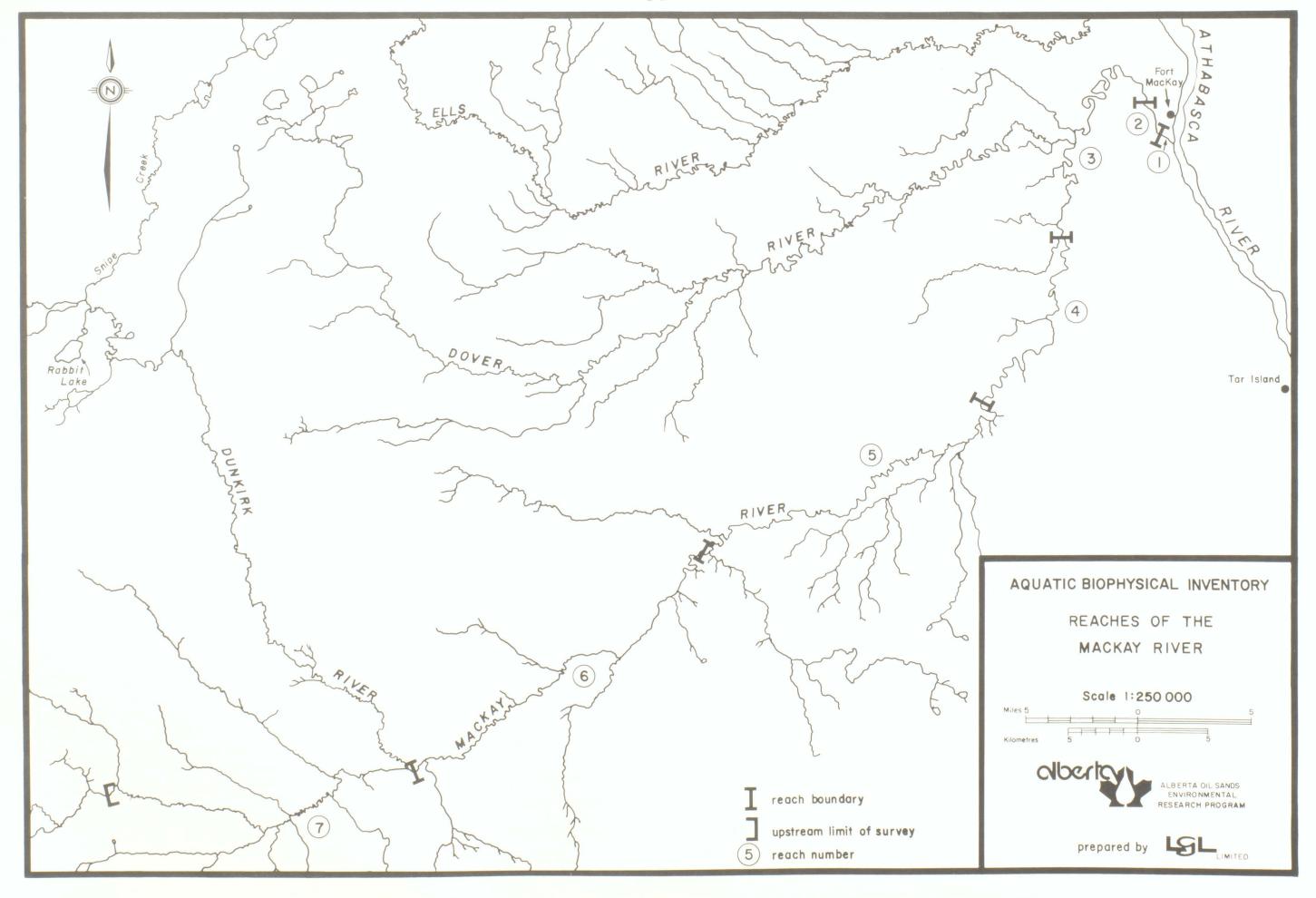








# MACKAY RIVER



Species	Adults	Juveniles and Young-of-the-year	Total Numbers
longnose dace	0	1	1
pearl dace	0	13	13
white sucker	4	2	6
Total	4	16	20

#### PHYSICAL CHARACTERISTICS

Reach length (km)	1.4
Channel width (m)	70
Channel area (ha)	9.8
Gradient (m/km)	1.4
Flow character	swirlin
Total pools (%)	90
Pattern	straigh
Confinement	confine
Unstable banks (%)	45
Substrate composition (%)	
fines (<2 mm)	25
gravels (2-64 mm)	45
larges (>64 mm)	15
bedrock and/or oil sand	15
Debris	low

#### REACH DESCRIPTION AND FISH UTILIZATION

This wide lower reach of the MacKay River is within the Athabasca River floodplain and flows in a straight pattern. There are a few high slumping banks and many areas with unstable, undercut banks. Gravel bars are numerous and some sand bars are present at the mouth of the river. The gradient is moderate, and flow characteristics in the reach are almost entirely shallow, swirling pool conditions. The substrate consists primarily of gravels, with some areas of sand. Deciduous trees and shrubs dominate the riparian vegetation, but conifers are also fairly numerous and grasses are abundant. Very little vegetation overhangs

The gravel substrate in this reach possibly provides suitable spawning areas for some of the fish species present in the MacKay River (e.g., longnose sucker, white sucker, trout-perch). Some of the areas with sandy substrates and moderate currents may be suitable for spawning by a few of the forage fish species, particularly pearl dace. Because of the general lack of debris or other shelter, this area is not considered to provide good rearing habitat. Although the mouth area may provide a resting area for fish migrating upstream in the Athabasca River, the potential for resting and feeding of adult fish is considered poor in the majority of the reach because there is little shelter and water depths are shallow. The shallow water probably precludes overwintering of fish in this reach.

### BENTHIC INVERTEBRATES

INSECTA Ephemeroptera Trichoptera Diptera Simuliidae

### RIPARIAN VEGETATION

Bank coverage (%) Coniferous trees 30 65 Deciduous trees Shrubs Grasses Barren Channel cover (%) Overhang

#### BENTHIC ALGAL PRODUCTIVITY

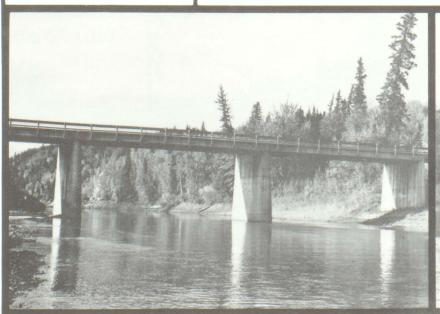
No data available for this reach

#### STREAM GAUGING DATA

No data available for this reach

#### WATER QUALITY

No data available for this reach



Bridge on highway 63 at km 0.6.



Looking downstream from km 0.6 towards confluence with the Athabasca River.

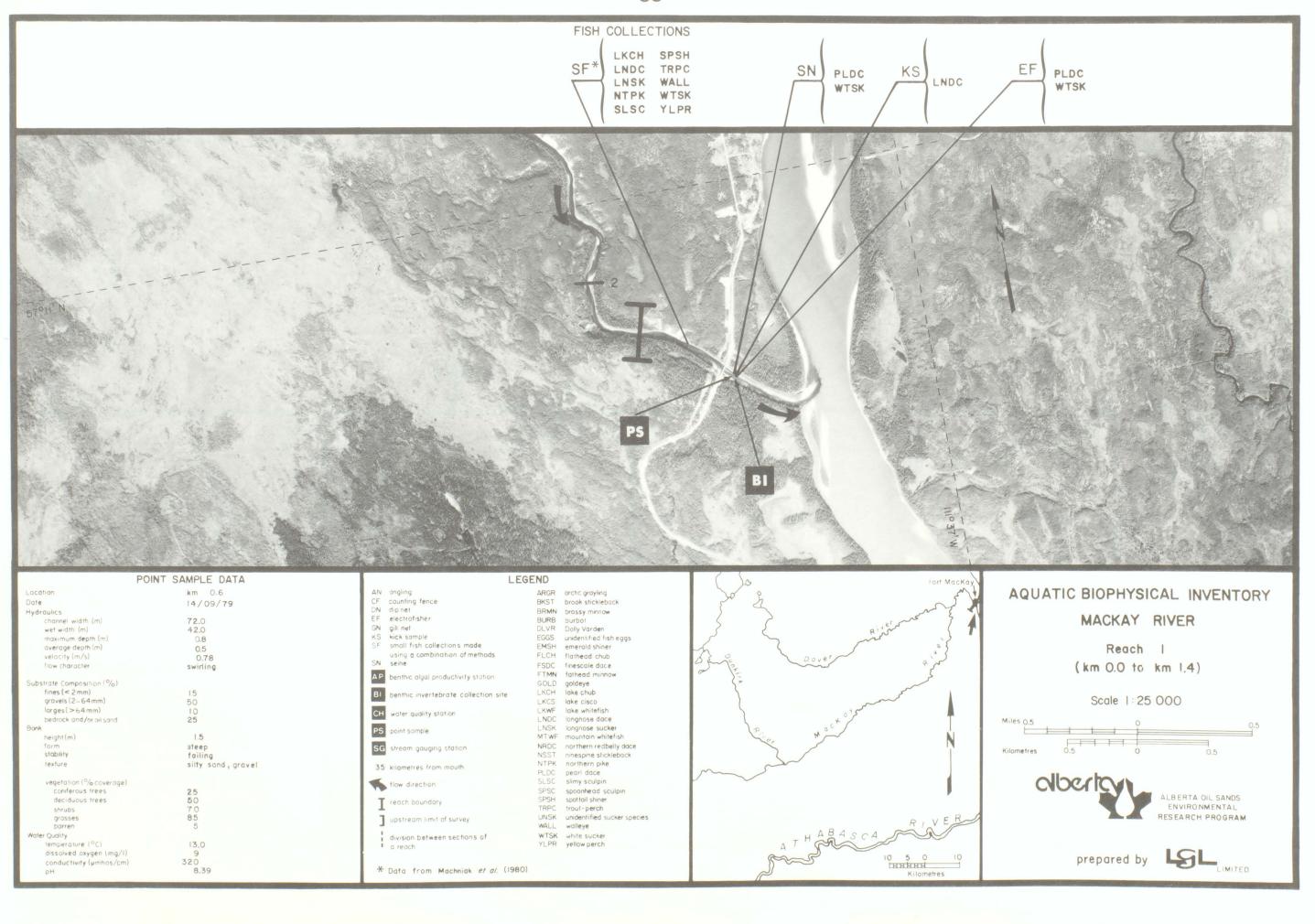
### AQUATIC BIOPHYSICAL INVENTORY MACKAY RIVER

Reach I

(km 0.0 to km 1.4)







	Adults	Juveniles and Young-of-the-year	Total Numbers
pearl dace	2	42	44
trout-perch	0	26	26
walleye	0	4	4
white sucker	0	10	10
Total	2	82	84

#### PHYSICAL CHARACTERISTICS

Reach length (km)	3.1
Channel width (m)	31
Channel area (ha)	9.6
Gradient (m/km)	1.5
Flow character	swirling
Total pools (%)	95
Pattern	sinuous
Confinement	entrenched
Unstable banks (%)	25
Substrate composition (%)	
fines (<2 mm)	35
gravels (2-64 mm)	60
larges (>64 mm)	0
bedrock and/or oil sand	5
Debris	low

#### REACH DESCRIPTION AND FISH UTILIZATION

This short reach lies just above the Athabasca River floodplain and flows in a sinuous pattern through a narrow valley. The steep valley walls are 40 to 50 m high and there are several areas with high, near-vertical, slumping banks. The gradient is moderate and the reach consists almost entirely of swirling pools. The substrate consists of gravels with some sandy areas. Riparian vegetation is primarily deciduous trees and shrubs with some stands of conifers. Grasses are

This reach provides many areas that should be good for spawning of those fish species that require gravel substrates. Arctic grayling, longnose sucker, white sucker and trout-perch have all been collected in the lower reaches of the MacKay River and all spawn over gravel substrates. Rearing potential is considered fair; some grassy shallow areas provide the only suitable habitat. Because of the relatively deep water and the many pools, the potential for adult fish resting and feeding is considered good. The deep pools also provide several good areas for overwintering of fish.

### BENTHIC INVERTEBRATES OLIGOCHAETA GASTROPODA

PELECYPODA Musculium

INSECTA Collembola Ephemeroptera

Odonata

Plecoptera Trichoptera

Polycentropus Diptera Tipulidae

Ceratopogonidae Chironomidae Chironominae Simuliidae

Tabanidae

#### RIPARIAN VEGETATION

Bank coverage (%) Coniferous trees 30 60 Deciduous trees Shrubs Grasses Barren Channel cover (%) Overhang Crown

#### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

#### STREAM GAUGING DATA

No data available for this reach

#### WATER QUALITY

No data available for this reach



Swirling flow character, typical of reach 2, at km 2.5.

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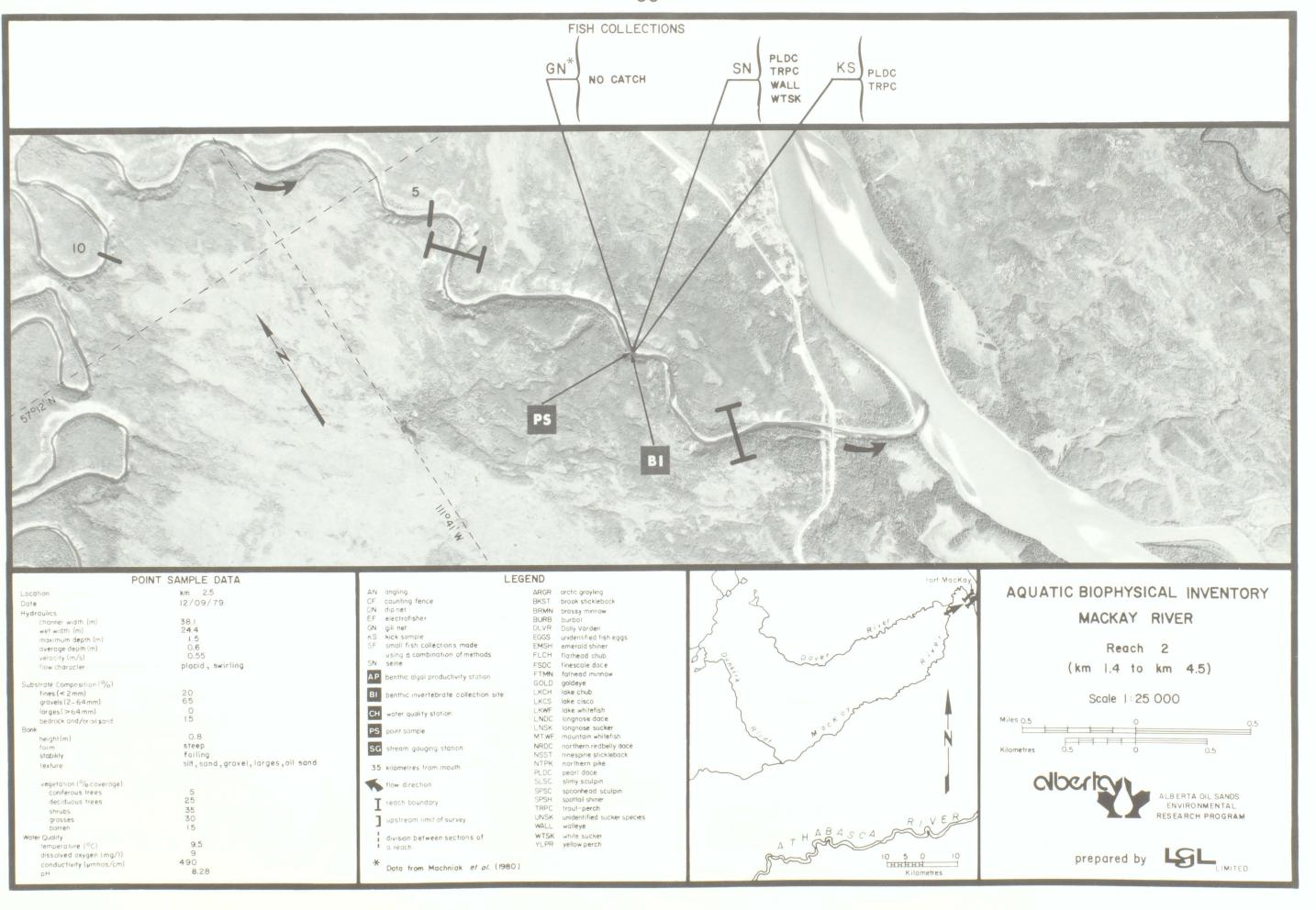
MacKay River at km 2.5.

### AQUATIC BIOPHYSICAL INVENTORY MACKAY RIVER

Reach 2 (km 1.4 to km 4.2)







Species	Adults	Juveniles and Young-of-the-year	Total Numbers
flathead chub	0	3	3
lake chub	1	9	10
longnose dace	0	5	5
longnose sucker	0	2	2
pearl dace	0	207	207
slimy sculpin	0	2	2
spoonhead sculpin	1	0	1
trout-perch	8	11	19
unidentified fry	N/A	20	20
walleye	0	3	3
white sucker	0	6	6
Total	10	268	278

#### PHYSICAL CHARACTERISTICS

Reach length (km)	35.5
Channel width (m)	28
Channel area (ha)	99.4
Gradient (m/km)	1.3
Flow character	swirling, rolling, broke
Total pools (%)	75
Pattern	tortuously meandering
Confinement	entrenched
Unstable banks (%)	60
Substrate composition (%)	
fines (<2 mm)	10
gravels (2-64 mm)	30
larges (>64 mm)	20
bedrock and/or oil sand	40
Debris	low

#### REACH DESCRIPTION AND FISH UTILIZATION

This tortuously meandering section is entrenched within a canyon that is cut 40 to 50 m deep into the McMurray Oil Sands formation. There is a very high proportion of unstable banks, which are primarily high, near-vertical, slumping areas. Exposed oil sands deposits are common, and a film of oil on the water surface is visible from the air in many places. Gradient and water velocities are moderate, and there are numerous riffle areas in addition to many relatively deep pools. The substrate consists primarily of gravels and larges with oil sand being a major component of the substrate in many places. The riparian vegetation is dominated by deciduous trees and shrubs and there are scattered patches of conifers. Very little vegetation overhangs the banks.

Several areas, where the substrate is primarily gravel, appear suitable for spawning of a number of fish species (e.g., arctic grayling, longnose sucker, white sucker, trout-perch). Suitable rearing areas for young-of-the-year of many species are provided by the numerous shallow areas with slow currents and gravel and rock substrates. Adults and juveniles of most fish species that occur in the MacKay River have been collected in this reach. The numerous pools of this reach provide good resting and feeding areas for adult fish and the abundance of forage fish species and young of other species provides good feeding potential for piscivores. The water depths in many of the large pools in this reach are probably sufficient to allow overwintering by fish.

#### BENTHIC INVERTEBRATES PELECYPODA

INSECTA Ephemeroptera Odonata

Trichoptera Diptera Tipulidae Chironomidae Orthocladiinae Tabanidae

Hemiptera

#### RIPARIAN VEGETATION

Bank coverage (%) Coniferous trees Deciduous trees 65 Grasses Barren Channel cover (%) Overhang

#### BENTHIC ALGAL PRODUCTIVITY

Data from Hickman et al. (1980)

Standing crop expressed as cell counts (number·m<sup>-2</sup>)  $381.0 \times 10^{1}$ maximum:  $1400.0 \times 10^{10}$ minimum:  $14.0 \times 10^{10}$ Standing crop expressed as chlorophyll  $\alpha$  (mg·m<sup>-2</sup>) Primary productivity (mg C·h<sup>-1</sup>·m<sup>-2</sup>) mean: maximum: 26.0

#### STREAM GAUGING DATA

Water Survey of Canada station number 07DB001

Maximum total annual discharge:  $852.3 \times 10^6 \text{ m}^3$  (1973) Minimum total annual discharge:  $185.0 \times 10^6 \text{ m}^3$  (1977) Maximum annual mean discharge: 27.01 m<sup>3</sup>/s (1973) Minimum annual mean discharge: 5.89 m<sup>3</sup>/s (1977) Maximum monthly mean discharge: 157.16 m<sup>3</sup>/s (June 1973) Minimum monthly mean discharge: Maximum daily discharge: 302.39 m<sup>3</sup>/s (June 18, 1973) 0.02 m3/s (March 2, 1973) Minimum daily discharge:

Data for 1972 to 1978 compiled from Loeppky and Spitzer (1977). Warner and Spitzer (1979) and Warner (1979).

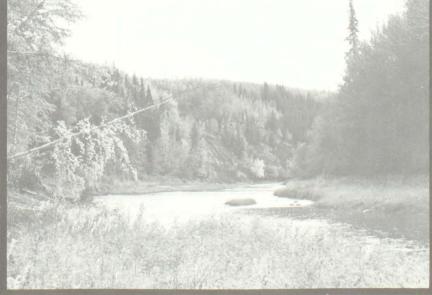
#### WATER QUALITY

Water Survey of Canada station number 00AT07DB0011

	Mean	Maximum	Minimum
Total alkalinity (mg CaCO <sub>3</sub> /1) pH	163.0 7.80	577.0 8.50	13.4
Total hardness (mg CaCO <sub>3</sub> /1)	166.0	493.1	59.3
Conductance (µS/cm)	392	1370	102
Total filterable			
residue fixed (mg/l)	198	781	51
Total non-filterable			
residue fixed (mg/1)	35	463	< 0.4
Total organic carbon (mg C/1)	31.0	59.0	9.0
Silica (mg SiO <sub>2</sub> /1)	6.9	20.0	1.0
Nitrate and nitrite nitrogen (mg N/1)	0.130	0.694	< 0.003
Total Kjeldahl nitrogen (mg N/1)	1.35	4.20	0.31
Total Phosphorus (mg P/1)	0.080	0.260	0.024
Orthophosphate (mg P/1)	0.030	0.100	< 0.003
Sulphate (mg SO <sub>4</sub> /1)	34.0	100.0	1.2

Data for the period January 1976 to December 1979 obtained from the National Water Quality Data Bank (NAQUADAT).

Unstable bank at km 13.8.



MacKay River at km 28.5.

### AQUATIC BIOPHYSICAL INVENTORY MACKAY RIVER

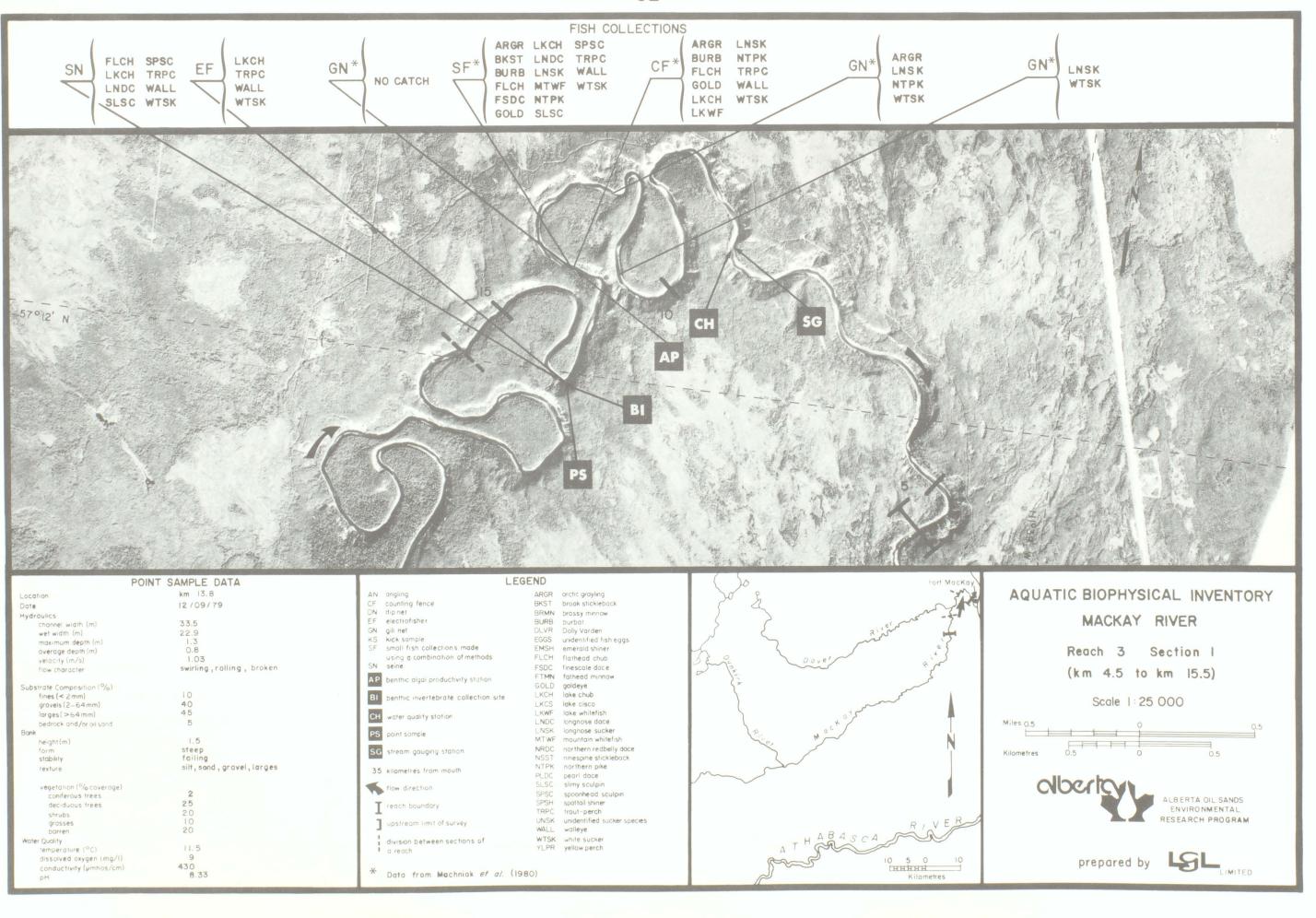
Reach 3 (km 4.2 to km 40.0)

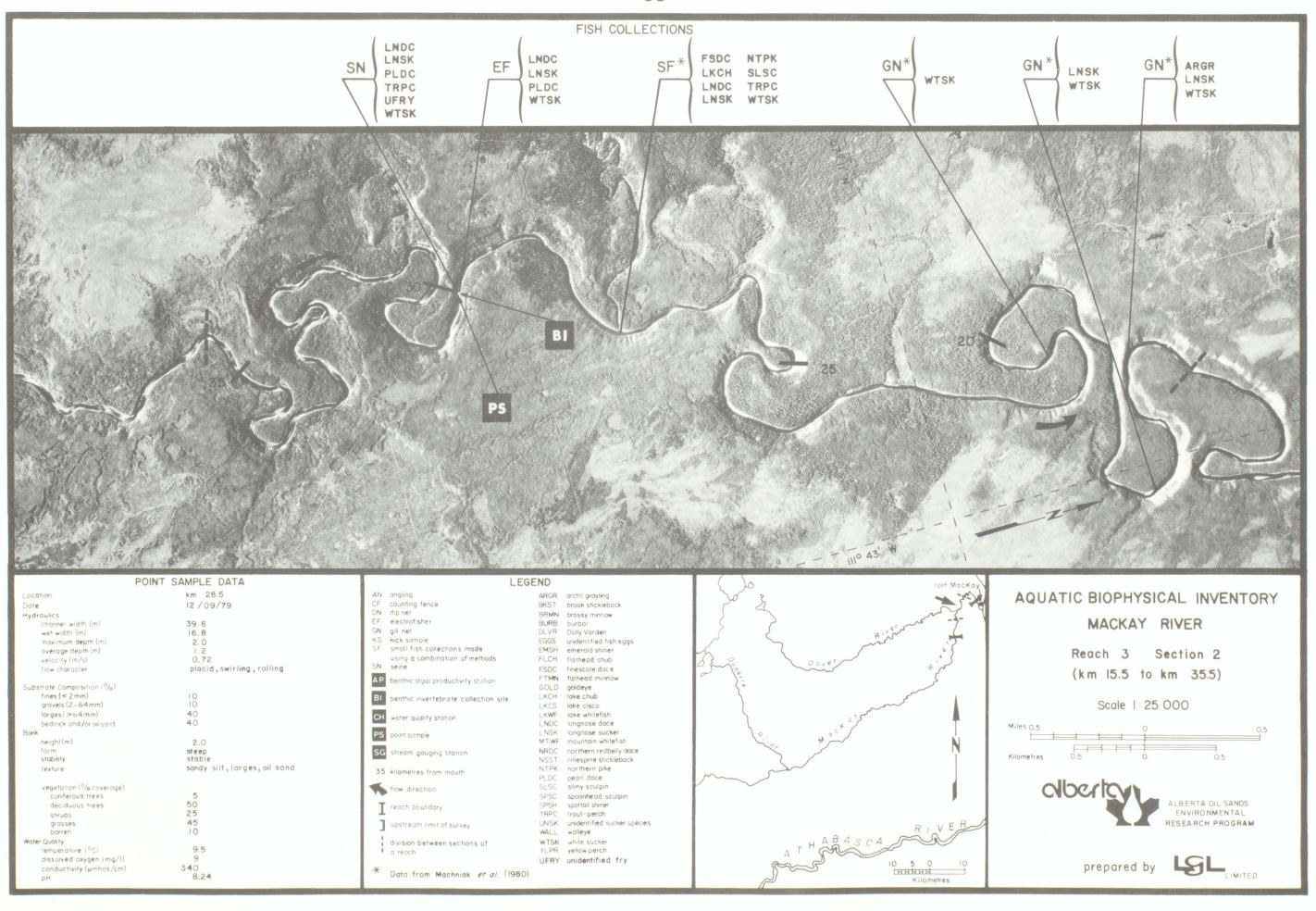


ALBERTA OIL SANDS ENVIRONMENTAL

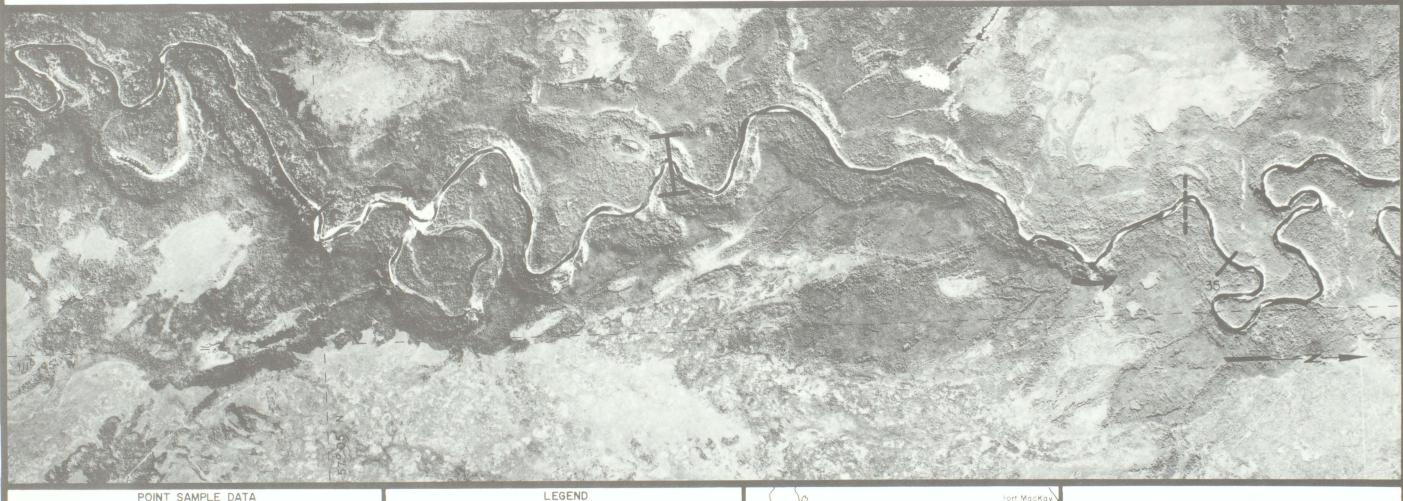
prepared by LSL LIMITED







#### FISH COLLECTIONS



ARGR arctic grayling

BRMN brassy minnow BURB burbot DLVR Dolly Varden

EMSH emerald shiner FLCH flathead chub

FSDC finescale dace FTMN fathead minnow

GOLD goldeye

LKCH lake chub

LKCS lake cisco LKWF lake whitefish

LNDC longnose dace

LNSK longnose sucker
MTWF mountain whitefish
NRDC northern redbelly dace

NSST ninespine stickleback NTPK northern pike

PLDC pearl dace SLSC slimy sculpin SPSC spoonhead sculpin

SPSH spottail shiner
TRPC trout-perch

WALL walleye WTSK white sucker YLPR yellow perch

BKST brook stickleback

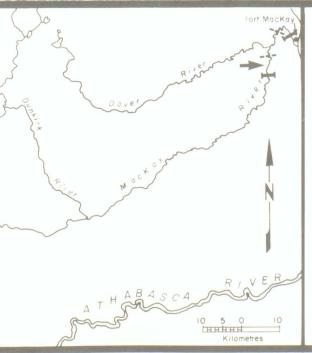
EGGS unidentified fish eggs

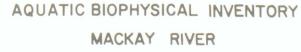
#### POINT SAMPLE DATA Location Date Hydraulics channel width (m) wet width (m) maximum depth (m) average depth (m) velocity (m/s) flow character Substrate Composition (%) fines (< 2 mm) gravels (2-64mm) larges(>64mm) bedrock and/or oil sand height(m) form stability texture vegetation (% coverage) coniferous trees deciduous trees shrubs grasses barren Water Quality temperature (°C) dissolved oxygen (mg/l) conductivity (µmhos/cm)

### CF counting fence DN dip net EF electrofisher GN gill net KS kick sample SF small fish collections made using a combination of methods SN seine AP benthic algal productivity station BI benthic invertebrate collection site CH water quality station PS point sample SG stream gauging station 35 kilometres from mouth flow direction T reach boundary upstream limit of survey

division between sections of a reach







Reach 3 Section 3 (km 35.5 to km 40.0)









Species	Adults	Juveniles and Young-of-the-year	Total Numbers
finescale dace	4	15	19
longnose dace	0	11	11
pearl dace	0	128	128
trout-perch	0	3	3
white sucker	0	4	4
Total	4	161	165

#### PHYSICAL CHARACTERISTICS

Reach length (km)	25.5
Channel width (m)	50
Channel area (ha)	127.5
Gradient (m/km)	2.2
Flow character	swirling, rolling
Total pools (%)	60
Pattern	irregularly meandering
Confinement	confined
Unstable banks (%)	15
Substrate composition (%)	
fines (<2 mm)	20
gravels (2-64 mm)	40
larges (>64 mm)	40
bedrock and/or oil sand	0
Debris	low

#### REACH DESCRIPTION AND FISH UTILIZATION

This irregularly meandering section is confined by the valley walls, but evidence of lateral channel movement (i.e., oxbows and meander scars) within the valley is present. The banks on the outside of bends in the river are often steep and slumping, but the proportion of the banks that are unstable is much less than in Reach 3. The gradient in this reach is steeper than in Reach 3 and water velocities are relatively high. Pools comprise a little over half of the reach area and are generally shallow. The substrate in this reach consists primarily of larges and coarse gravels, with sand and silt present in the pools. Although the riparian vegetation is mostly deciduous trees and shrubs, some patches of conifers are present and grasses are abundant.

The gravel substrates and many riffles in this reach provide areas that are excellent for spawning of arctic grayling, longnose sucker, white sucker, longnose dace and trout-perch. Those areas with large rocks and slower currents are probably suitable for spawning of lake chub and slimy sculpin. The rearing potential of this reach is considered good because areas with large rock substrates provide adequate shelter. Areas suitable for resting and feeding of adult fish are provided by the numerous pools in this reach. Because forage fish are abundant in this reach, feeding potential for piscivorous species is considered good. Because the pools in this reach are relatively shallow, overwintering of fish is probably not possible except in isolated deep pools.

### BENTHIC INVERTEBRATES NEMATODA

OLIGOCHAETA GASTROPODA

PELECYPODA Pisidium

INSECTA

Ephemeroptera Paraleptophlebia

Odonata

Plecoptera Trichoptera Diptera Tipulidae Chironomidae Chironominae Tanypodinae Orthocladiinae Tabanidae

Dolichopodidae

#### RIPARIAN VEGETATION

Bank coverage (%) Coniferous trees Deciduous trees Shrubs Grasses Barren Channel cover (%) Overhang Crown

#### BENTHIS ALGAL PRODUCTIVITY

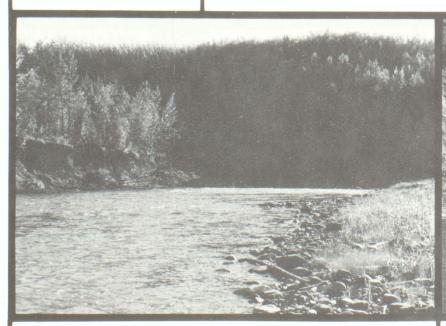
No data available for this reach

#### STREAM GAUGING DATA

No data available for this reach

#### WATER QUALITY

No data available for this reach



Section of riffles with slumping bank on left at km 45.1.



High, eroding bank of sand and silt at km 63.8.

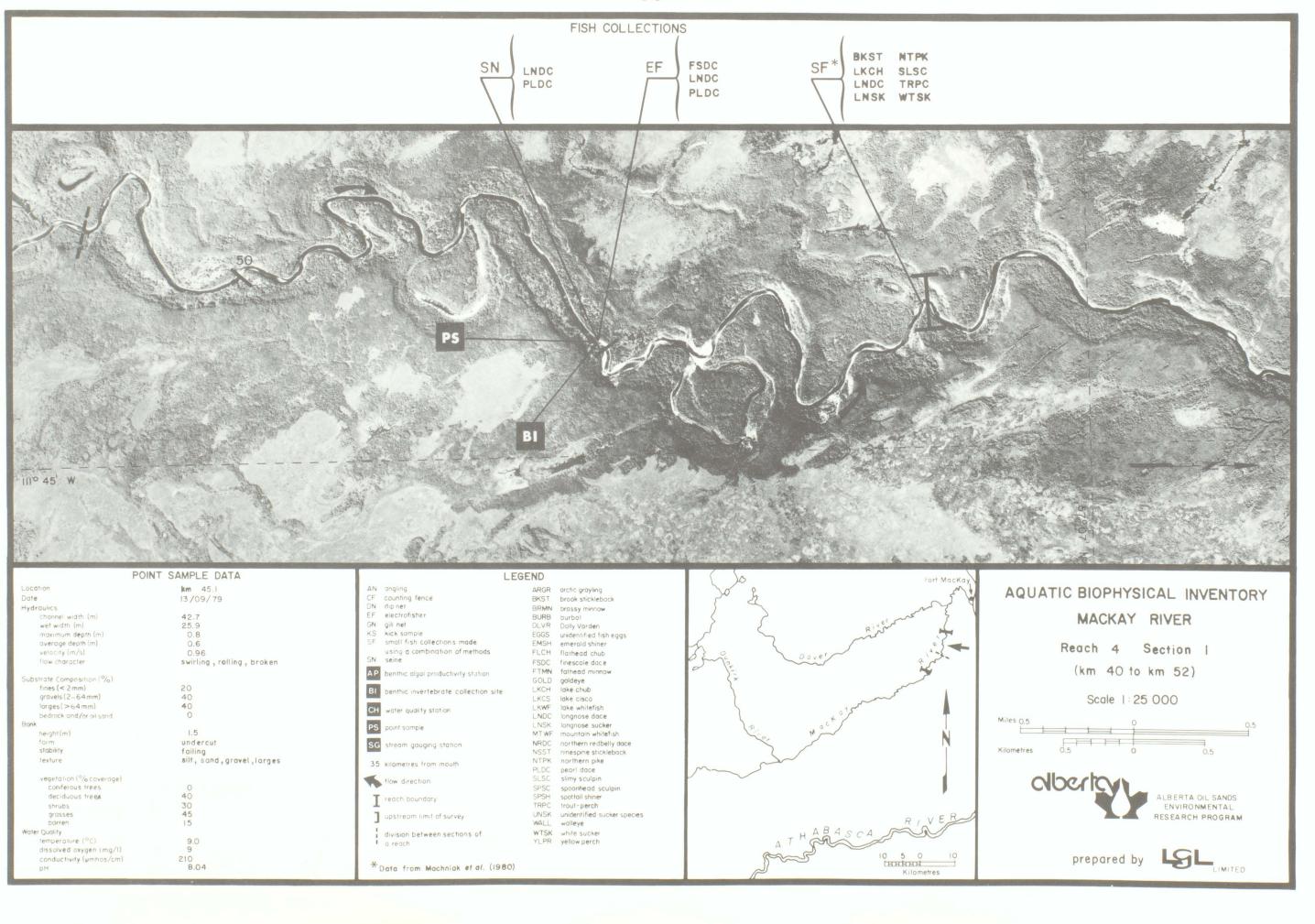
### AQUATIC BIOPHYSICAL INVENTORY MACKAY RIVER

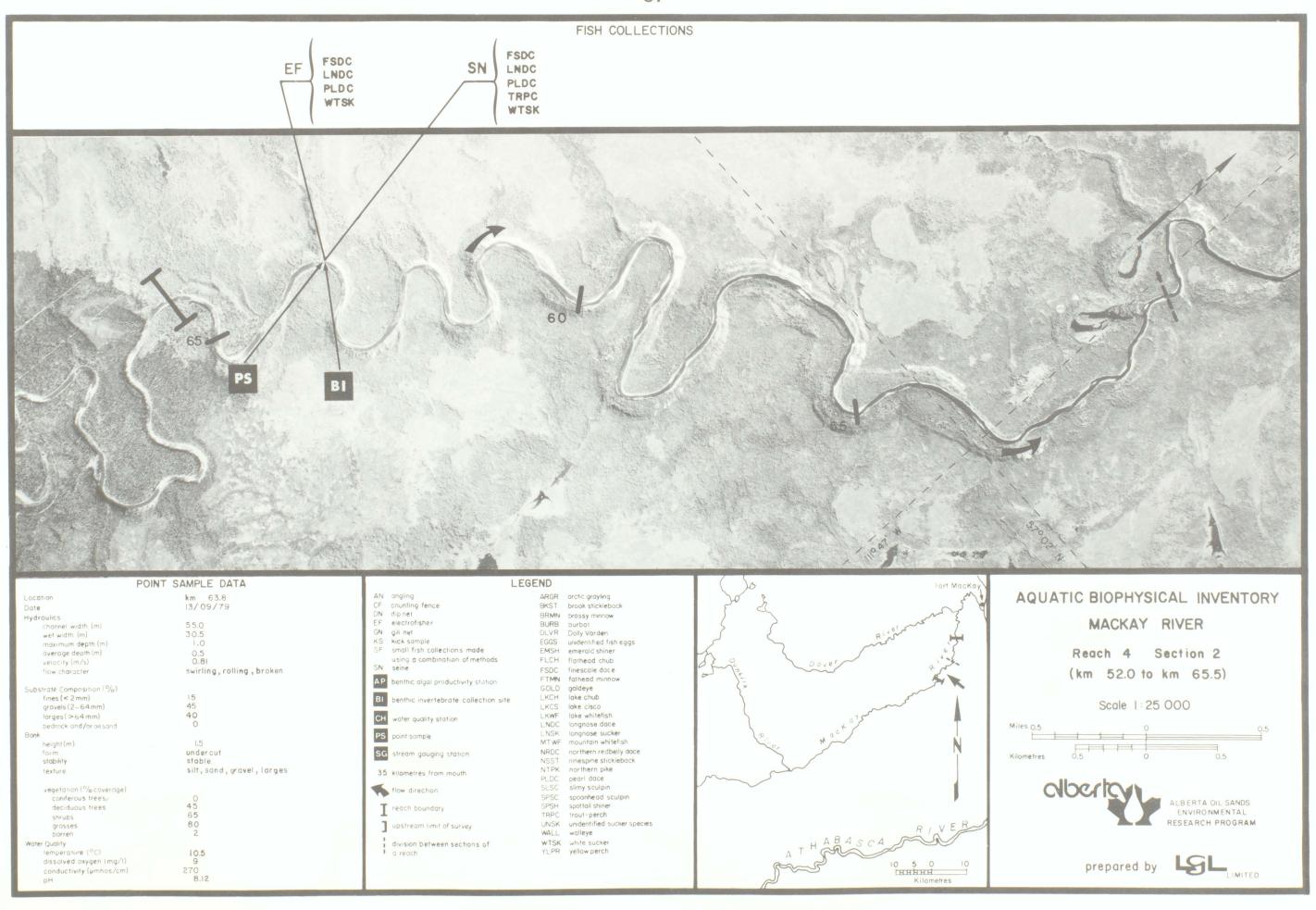
Reach 4

(km 40.0 to km 65.5)









Species	Adults	Juveniles and Young-of-the-year	Total Numbers
finescale dace	1	0	1
longnose dace	0	2	2
pearl dace	10	206	216
trout-perch	0	2	2
white sucker	0	9	9
Total	11	219	230

#### PHYSICAL CHARACTERISTICS

Reach length (km)	46.0
Channel width (m)	45
Channel area (ha)	207.0
Gradient (m/km)	2.4
Flow character	swirling, rolling, brok
Total pools (%)	40
Pattern	irregularly meanderin
Confinement	frequently confined
Unstable banks (%)	10
Substrate composition (%)	
fines (<2 mm)	10
gravels (2-64 mm)	50
larges (>64 mm)	40
bedrock and/or oil sand	0
Debris	low

#### REACH DESCRIPTION AND FISH UTILIZATION

This long, irregularly meandering section has a relatively high gradient and is essentially a series of riffles. The proportion of the reach area that consists of pools is the lowest in the surveyed portion of the MacKay River, and the flow character varies from swirling to rolling to broken. Areas with unstable banks are fairly common but are less frequent here than in the four lower reaches of the river. The substrate is almost entirely larges and gravels, with some sandy areas in quiet shallows along the banks. Coniferous trees are a dominant component of the riparian vegetation and deciduous trees and shrubs are also numerous. There is usually a dense growth of grasses along the banks and very little overhanging vegetation.

Although the spawning potential of this reach is considered good for arctic grayling, suckers, longnose dace and slimy sculpin, high water velocities and the large sizes of the substrate materials may limit spawning over much of the reach. The rearing potential of this reach is considered moderate; shelter is provided by large rocks in shallow areas along the banks and there are few grassy shallows. Because there are relatively few pools and the water is generally shallow and swiftly flowing, the resting and feeding potential for adults of the larger species is relatively poor. However, the many riffle areas should provide good feeding habitat for arctic grayling. The water depths in most of this reach are probably not sufficient for overwintering of fish.

#### BENTHIC INVERTEBRATES NEMATODA

OLIGOCHAETA GASTROPODA

PELECYPODA ARACHNIDA

CRUSTACEA Cladocera Amphipoda

Hyalella azteca

Ephemeroptera

Plecoptera

Hemiptera

Megaloptera

Trichoptera Coleoptera

Elmidae Diptera Chaoboridae Ceratopogonidae Chironomidae Tabanidae

#### RIPARIAN VEGETATION

Bank coverage (%) Coniferous trees 30 Deciduous trees Shrubs Grasses Barren Channel cover (%) Overhang

#### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

#### STREAM GAUGING DATA

No data available for this reach

#### WATER QUALITY

No data available for this reach



Recent slide at km 73.5 has entered river channel.



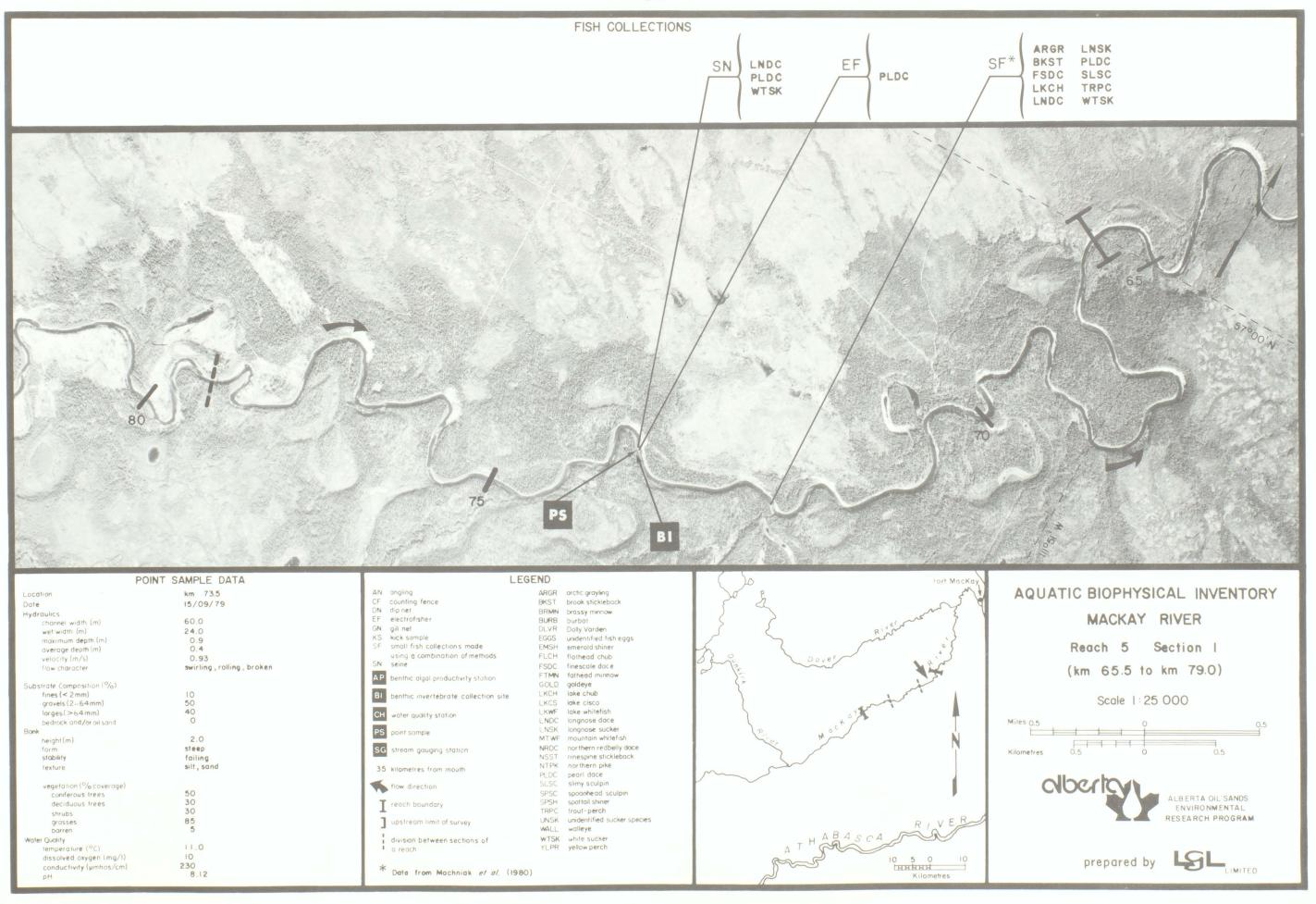
Long, swirling pool at km 91.5.

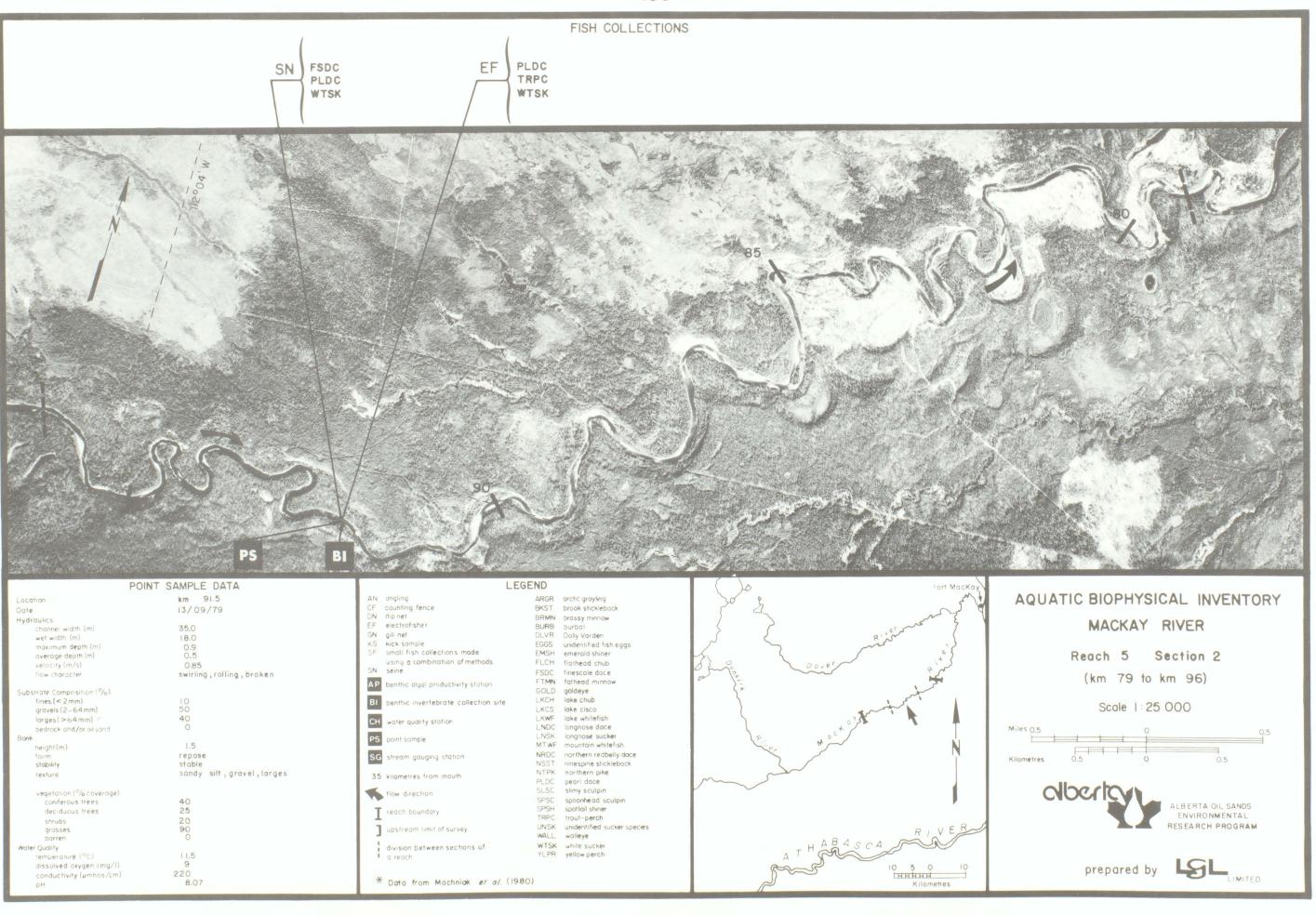
### AQUATIC BIOPHYSICAL INVENTORY MACKAY RIVER

Reach 5 (km 65.5 to km III,5)

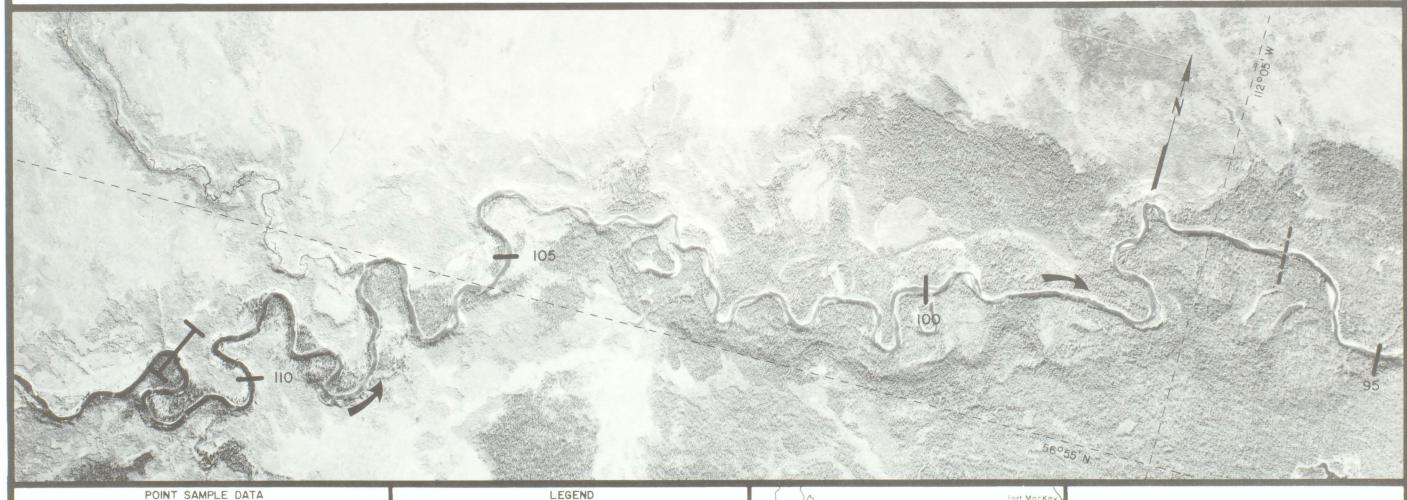








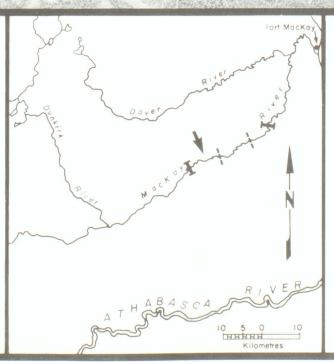




#### Location Date Hydraulics channel width (m) wet width (m) maximum depth (m) average depth (m) velocity (m/s) flow character Substrate Composition (%) fines (< 2 mm) gravels (2-64 mm) lorges(>64mm) bedrock and/or oil sand stability texture vegetation (% coverage) coniferous trees deciduous trees shrubs grasses barren Water Quality temperature (°C) dissolved oxygen (mg/l)

conductivity (µmhos/cm)

#### AN angling CF counting fence DN dip net EF electrofisher ARGR arctic grayling BKST brook stickleback BRMN brassy minnow BURB burbot DLVR Dolly Varden GN gill net KS kick sample SF small fish collections made EGGS unidentified fish eggs EMSH emerald shiner FLCH flathead chub using a combination of methods SN seine FSDC finescale dace FTMN fathead minnow AP benthic algal productivity station GOLD goldeye BI benthic invertebrate collection site LKCH lake chub LKCS lake cisco LKWF lake whitefish LNDC longnose dace CH water quality station LNSK longnose sucker MTWF mountain whitefish NRDC northern redbelly dace NSST ninespine stickleback PS point sample SG stream gauging station NTPK northern pike 35 kilometres from mouth PLDC pearl dace SLSC slimy sculpin SPSC spoonhead sculpin SPSH spottal shiner TRPC trout-perch UNSK walleye flow direction T reach boundary upstream limit of survey WTSK white sucker YLPR yellow perch division between sections of a reach



# AQUATIC BIOPHYSICAL INVENTORY MACKAY RIVER Reach 5 Section 3

(km 96.0 to km III.5)









Species	Adults	Juveniles and Young-of-the-year	Total Numbers
finescale dace	0	14	14
northern pike	0	3	3
pearl dace	2	89	91
slimy sculpin	4	0	4
white sucker	1	9	10
Total	7	115	122

#### PHYSICAL CHARACTERISTICS

Reach length (km)	40.0
Channel width (m)	38
Channel area (ha)	152.0
Gradient (m/km)	0.7
Flow character	placid, swirling, rolling
Total pools (%)	90
Pattern	irregularly meandering
Confinement	occasionally confined
Unstable banks (%)	2
Substrate composition (%)	
fines (<2 mm)	50
gravels (2-64 mm)	35
larges (>64 mm)	15
bedrock and/or oil sand	0
Debris	high

#### REACH DESCRIPTION AND FISH UTILIZATION

This section of the MacKay River has a much lower gradient than Reach 5 and meanders in an irregular pattern. Most of the reach consists of pools with placid or swirling flow, but there are a few riffle sections. Several beaver dams were present in this reach at the time the river was surveyed in 1979. The substrate consists primarily of fines and small gravels with some cobbles and boulders. Coniferous trees dominate the riparian vegetation over much of the reach, but deciduous trees and shrubs are also abundant and there is a dense growth of grasses in most places. There is a large amount of debris in the channel.

For most of the larger fish species, the spawning potential of the reach is poor. There are many areas, however, that are probably suitable for spawning of some forage fish species that spawn over sand or silt substrates. Some northern pike may also spawn in this reach. The rearing potential of this reach is considered very good; shelter is provided by abundant debris in shallow pool areas and there are some weedy shallows. The many deep pools and abundant debris provide good resting and feeding areas for adults of some of the larger fish species, particularly suckers and northern pike. The water depths over much of the reach are probably sufficient to allow overwintering of fish.

### BENTHIC INVERTEBRATES

GASTROPODA

PELECYPODA

ARACHNIDA Hydracarina CRUSTACEA Cladocera

INSECTA Ephemeroptera

Odonata

Plecoptera

Megaloptera

Trichoptera

Coleoptera Elmidae Diptera Tipulidae

Chironomidae Chironominae Tanypodinae Orthocladiinae

#### RIPARIAN VEGETATION

Bank coverage (%) Coniferous trees Deciduous trees 35 Shrubs Grasses Barren

Channel cover (%) Overhang Crown

#### BENTHIC ALGAL PRODUCTIVITY

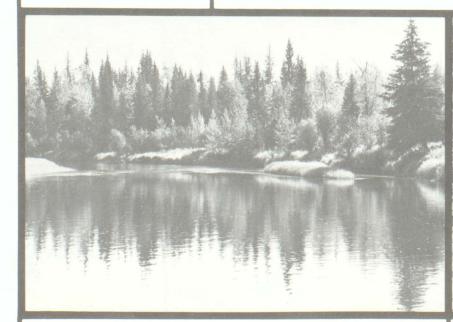
No data available for this reach

#### STREAM GAUGING DATA

No data available for this reach

#### WATER QUALITY

No data available for this reach



A typical area of reach 6 at km 141.5.



Large, deep pool at km 122.8.

### AQUATIC BIOPHYSICAL INVENTORY MACKAY RIVER

Reach 6 (km III.5 to km I51.5)



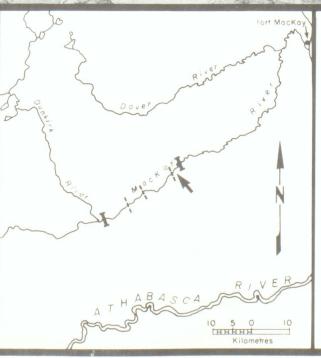


#### FISH COLLECTIONS



#### Location Date Hydraulics channel width (m) wet width (m) maximum depth (m) average depth (m) flow character Substrate Composition (%) fines (< 2 mm) gravels (2-64mm) larges (>64 mm) bedrock and/or oil sand stability texture vegetation (% coverage) coniferous trees deciduous trees shrubs grasses Water Quality dissolved oxygen (mg/l) conductivity (µmhos/cm)

#### AN angling ARGR arctic grayling BKST brook stickleback CF counting fence DN dip net EF electrofisher BRMN brassy minnow BURB burbot DLVR Dolly Varden GN gill net KS kick sample SF small fish collections made EGGS unidentified fish eggs EMSH emerald shiner using a combination of methods SN seine FLCH flathead chub FSDC finescale dace AP benthic algal productivity station FTMN fathead minnow GOLD goldeye BI benthic invertebrate collection site LKCH lake chub LKCS lake cisco CH water quality station LKWF lake whitefish LNDC longnose dace LNSK longnose sucker MTWF mountain whitefish PS point sample SG stream gauging station NRDC northern redbelly doce NSST ninespine stickleback NTPK northern pike 35 kilometres from mouth PLDC pearl dace SLSC slimy sculpin flow direction SPSC spoonhead sculpin SPSH spottail shiner TRPC trout-perch T reach boundary upstream limit of survey UNSK unidentified sucker species WALL walleye WTSK white sucker YLPR yellow perch division between sections of a reach



### AQUATIC BIOPHYSICAL INVENTORY MACKAY RIVER

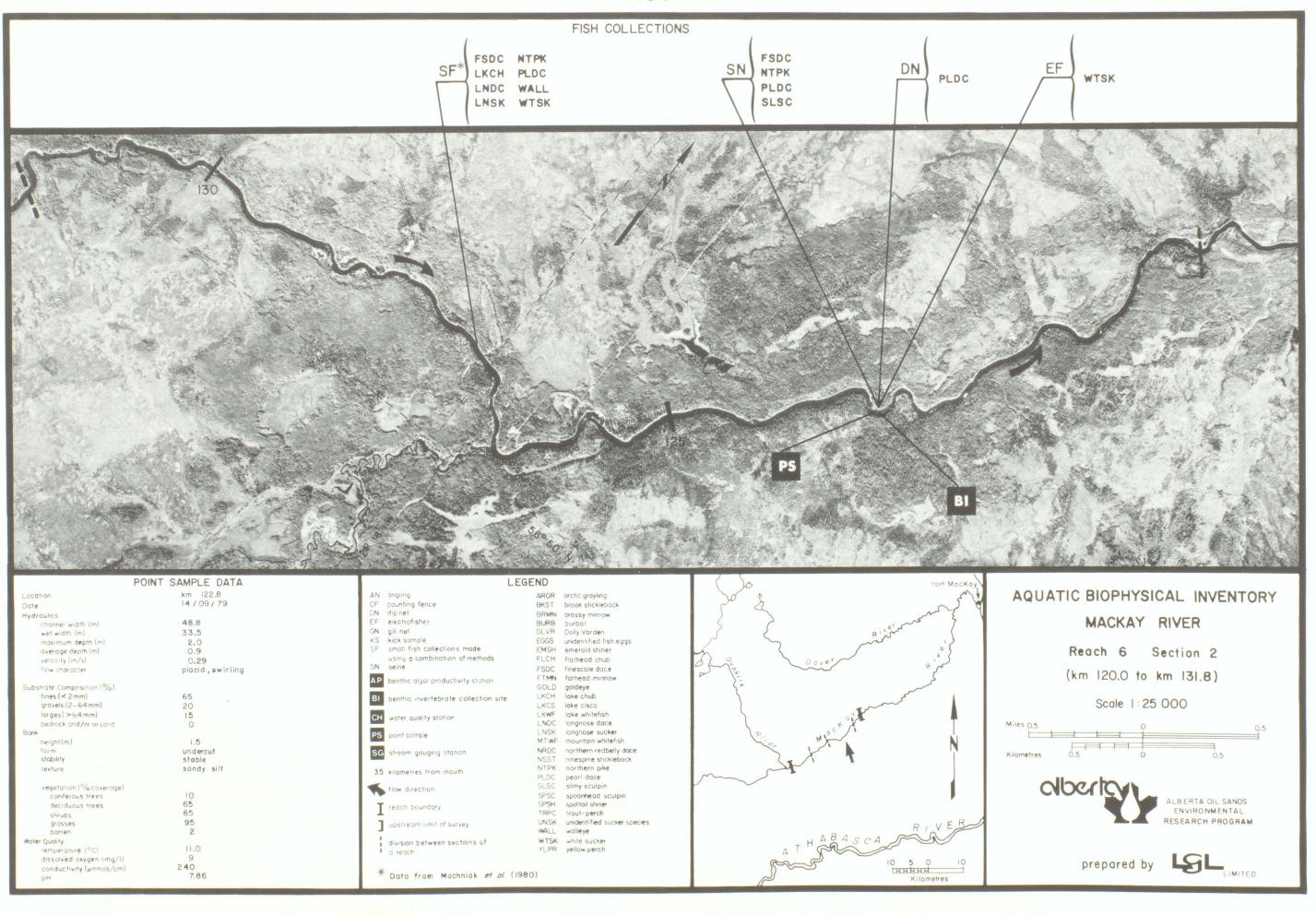
Reach 6 Section I (km 111.5 to km 120.0)

Scale 1:25 000

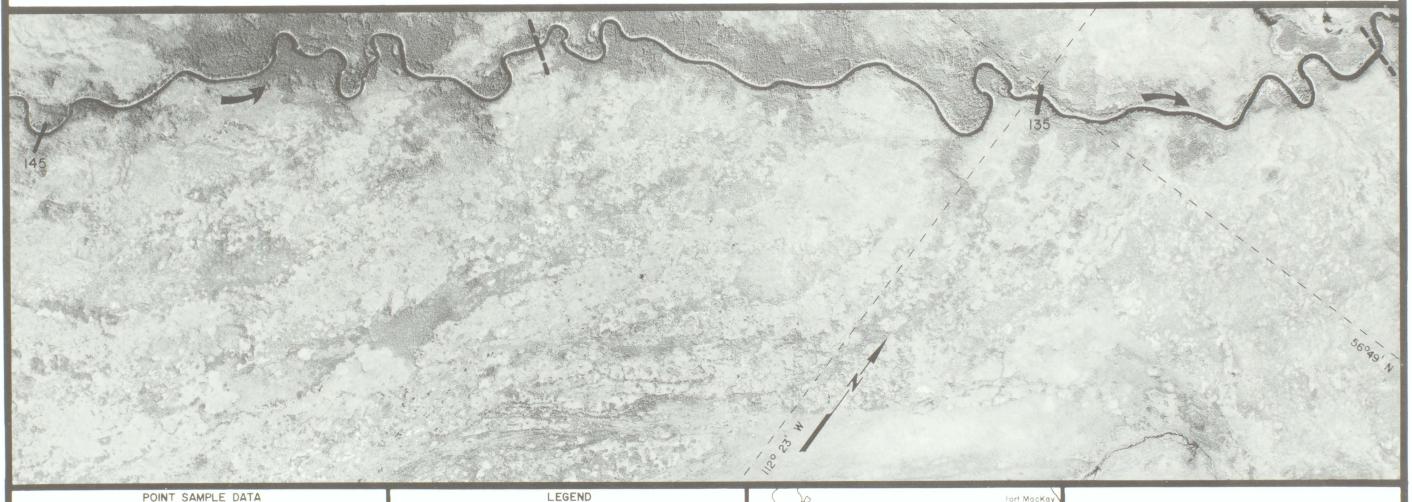




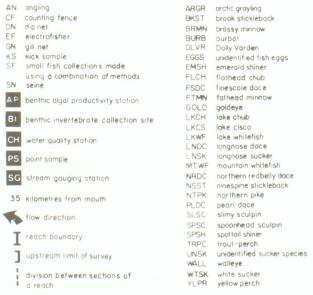


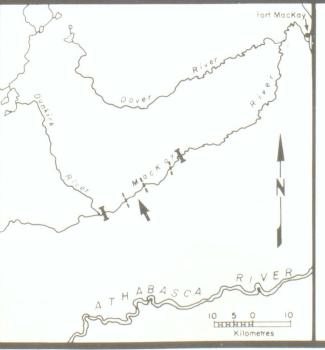






#### Location Date Hydraulics channel width (m) wet width (m) maximum depth (m) average depth (m) velocity (m/s) flow character Substrate Composition (%) gravels (2-64 mm) larges (>64 mm) bedrock and/or oil sand height(m) stability texture vegetation (% coverage) coniferous trees deciduous trees shrubs grasses Water Quality temperature (°C) dissolved oxygen (mg/l) conductivity (µmhos/cm)





### AQUATIC BIOPHYSICAL INVENTORY MACKAY RIVER

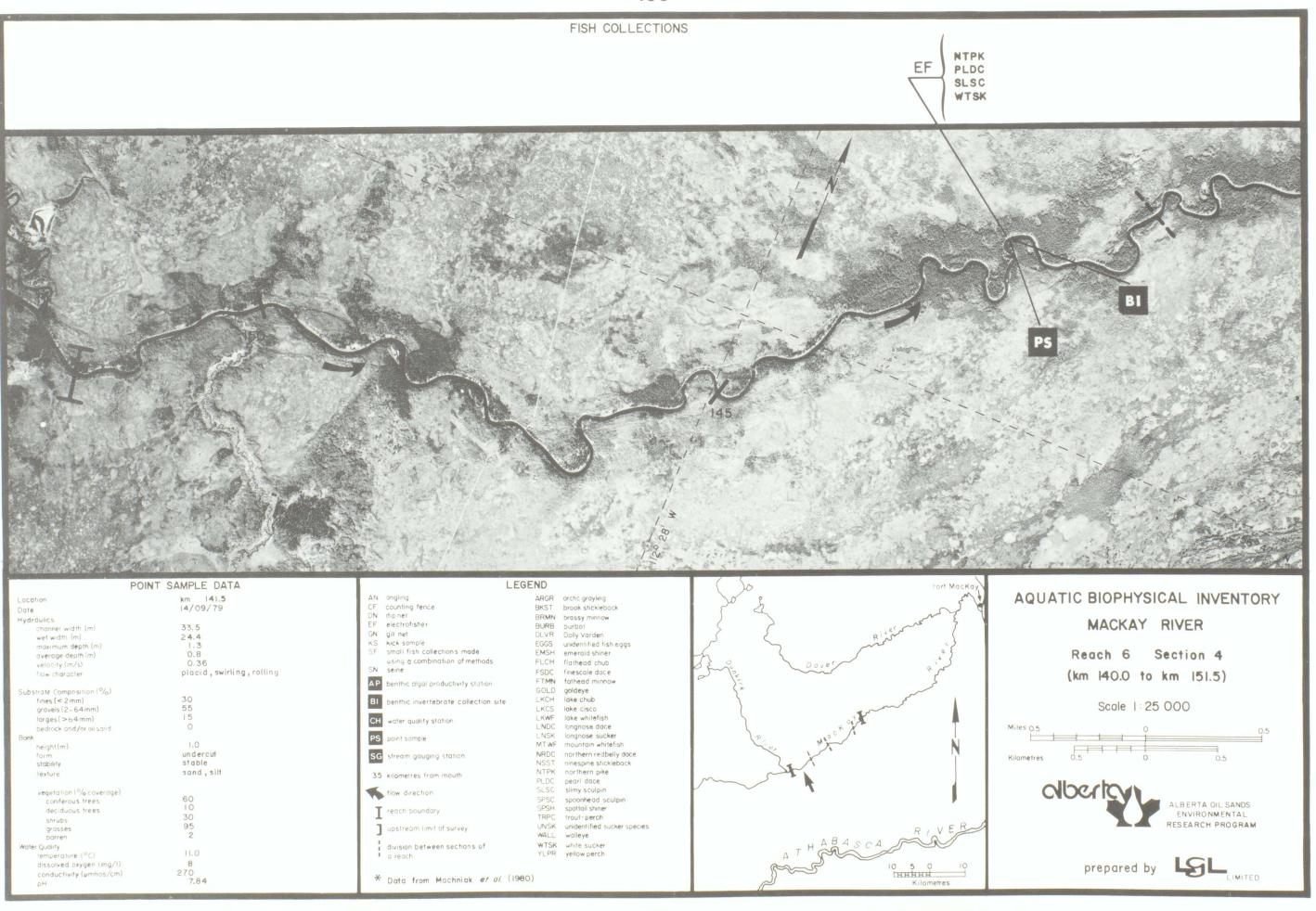
Reach 6 Section 3 (km 131.8 to km 140.0)

Scale 1:25 000









Juveniles and Adults Young-of-the-year Species Total Numbers

NO FISH CAUGHT

#### PHYSICAL CHARACTERISTICS

Reach length (km)	45.5
Channel width (m)	10
Channel area (ha)	45.5
Gradient (m/km)	0.5
Flow character	placid
Total pools (%)	100
Pattern	tortuously meandering
Confinement	unconfined
Unstable banks (%)	0
Substrate composition (%)	
fines (<2 mm)	100
gravels (2-64 mm)	0
larges (>64 mm)	0
bedrock and/or oil sand	0
Debris	high

#### REACH DESCRIPTION AND FISH UT!LIZATION

This uppermost reach of the surveyed portion of the MacKay River meanders in a tortuous pattern through a marshy area of treed muskeg. Several beaver dams were present at the time the river was surveyed in 1979. The gradient is very low and the flow is sluggish through the entire reach. The substrate consists of silt and clay with organic detritus. Aquatic vegetation is abundant, and there is a large amount of debris in the channel. The riparian vegetation is dominated by deciduous shrubs and a very dense growth of grasses. Deciduous trees are also numerous and there are some patches of conifers.

The abundant aquatic vegetation in this reach provides excellent spawning habitat for northern pike and brook stickleback. The reach does not appear to be suitable for spawning of other species. The large amount of debris and aquatic vegetation in this reach provides suitable rearing habitat for some species (e.g., brook stickleback and northern pike) and the water depth in this reach appears to be sufficient to allow overwintering of fish.

BENTHIC INVERTEBRATES
NEMATODA
OLIGOCHAETA HIRUDINEA GASTROPODA Aplexa Helisoma PELECYPODA

CRUSTACEA Cladocera

Amphipoda

INSECTA Ephemeroptera

> Baetis Baetisca

Odonata Libellulidae Perithemis

Agriidae Hemiptera Corixidae Trichoptera

. Limnephilus

Ptilostomis Coleoptera Dytiscidae Elmidae

Chrysomelidae Diptera Chaoboridae Culicidae

Tabanidae

Ceratopogonidae Chironomidae Chironominae Tanypodinae Orthocladiinae

#### RIPARIAN VEGETATION

Bank coverage (%) Coniferous trees 20 45 Deciduous trees 60 Shrubs Grasses 90 Barren Channel cover (%) Overhang 10 Crown

#### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

#### STREAM GAUGING DATA

No data available for this reach

#### WATER QUALITY

No data available for this reach



Placid flow and dense aquatic vegetation at km 158 is characteristic of



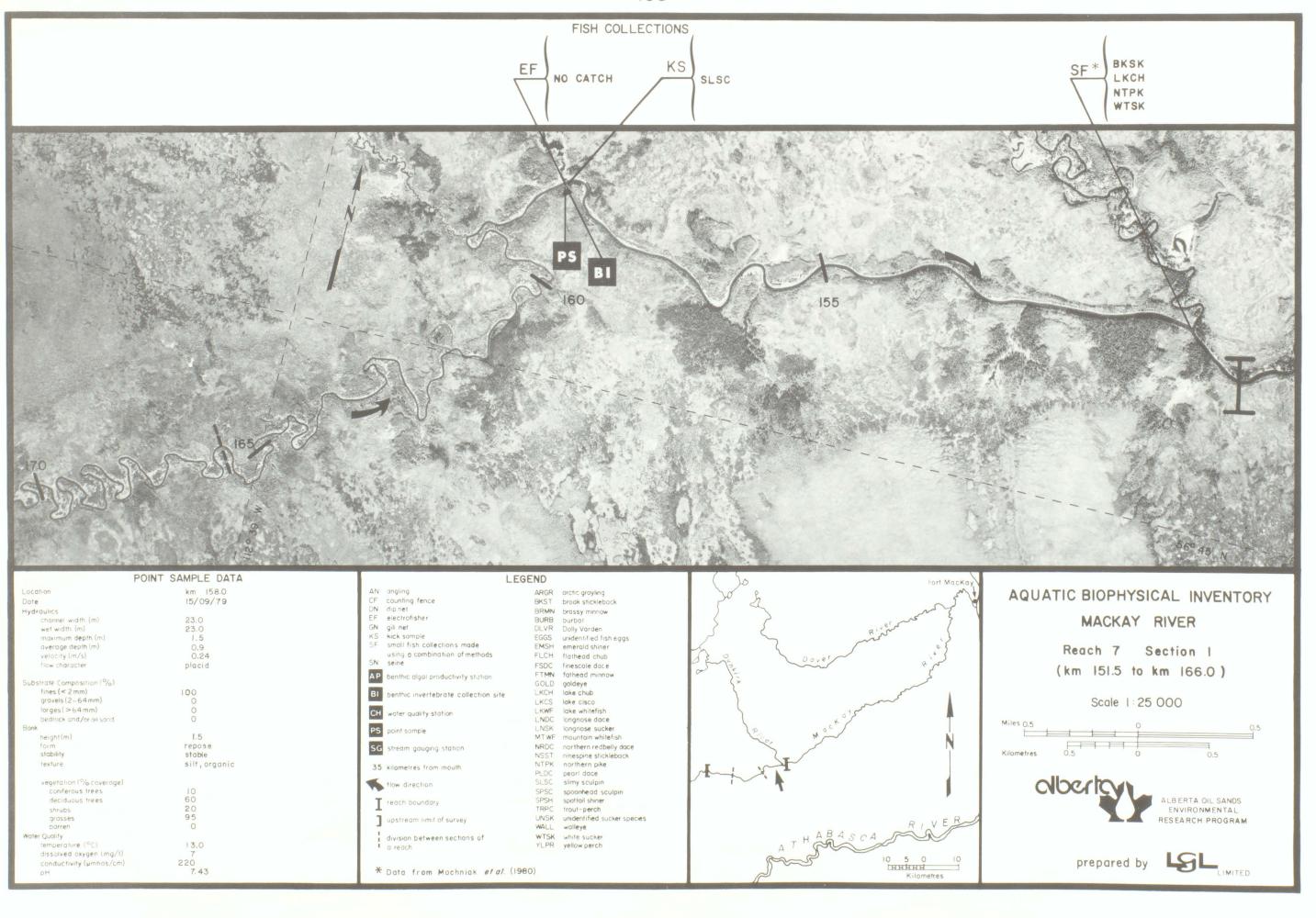
Very sluggish flow and dense aquatic vegetation at km 186.

## AQUATIC BIOPHYSICAL INVENTORY MACKAY RIVER

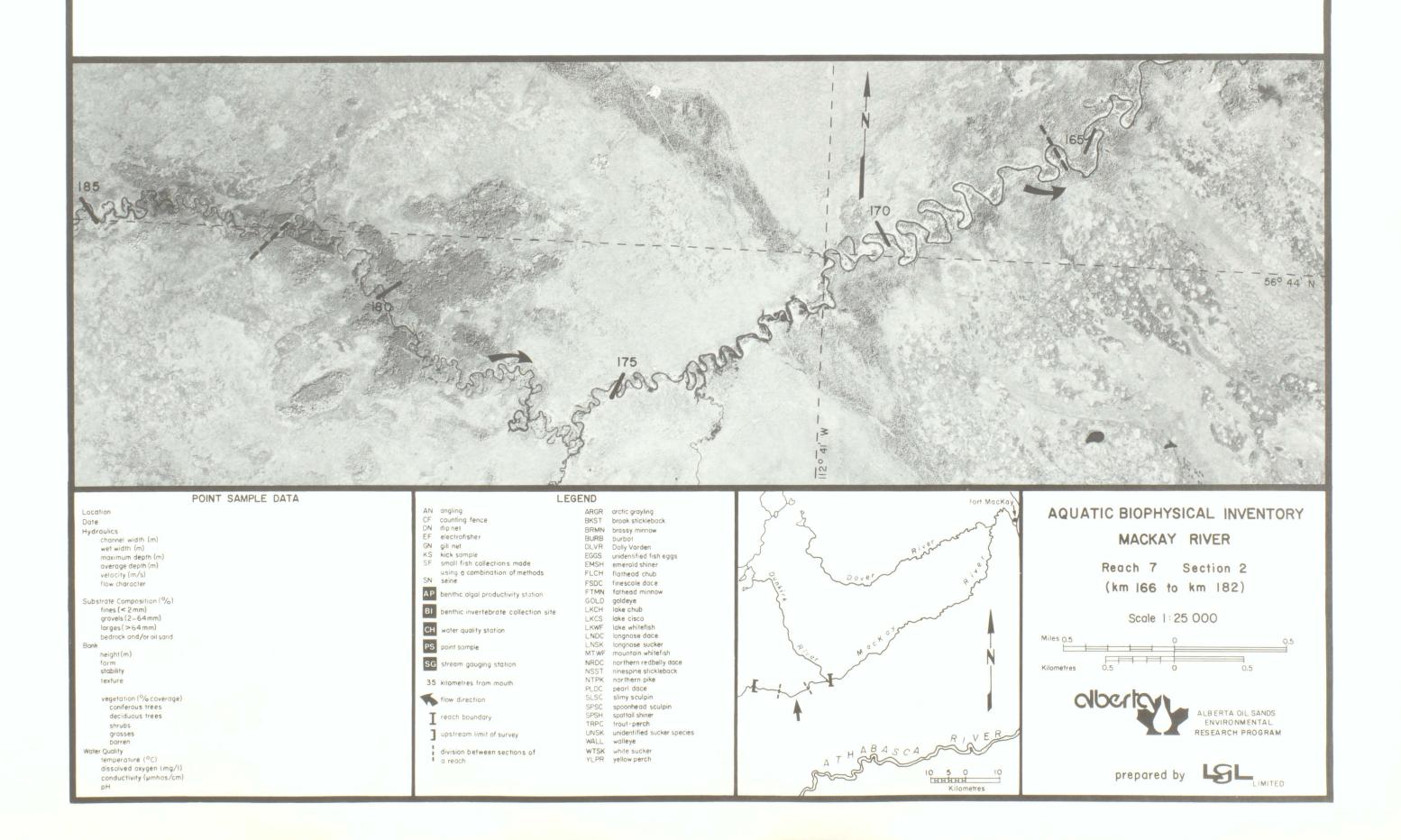
Reach 7 (km 151.5 to km 200.0)

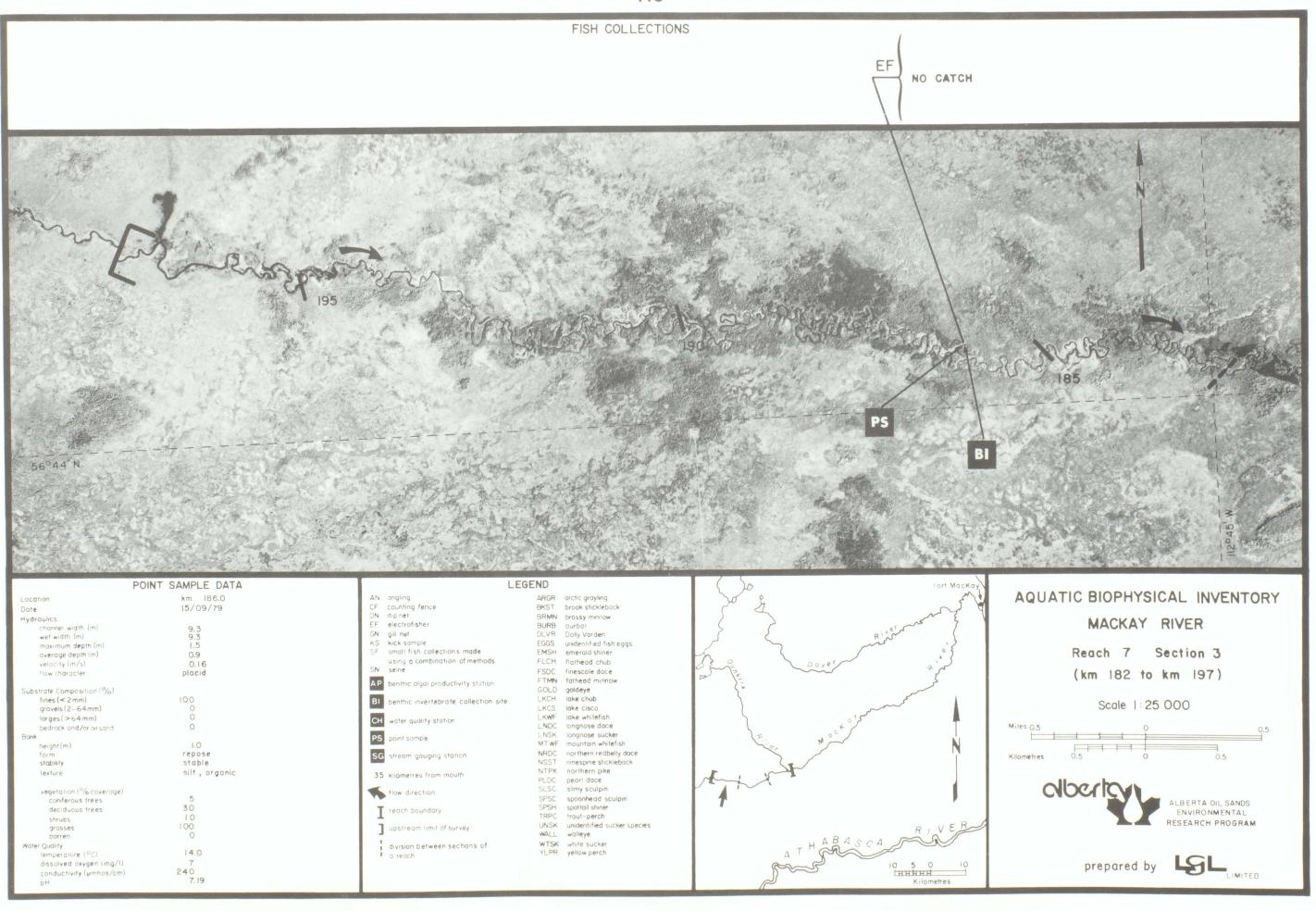




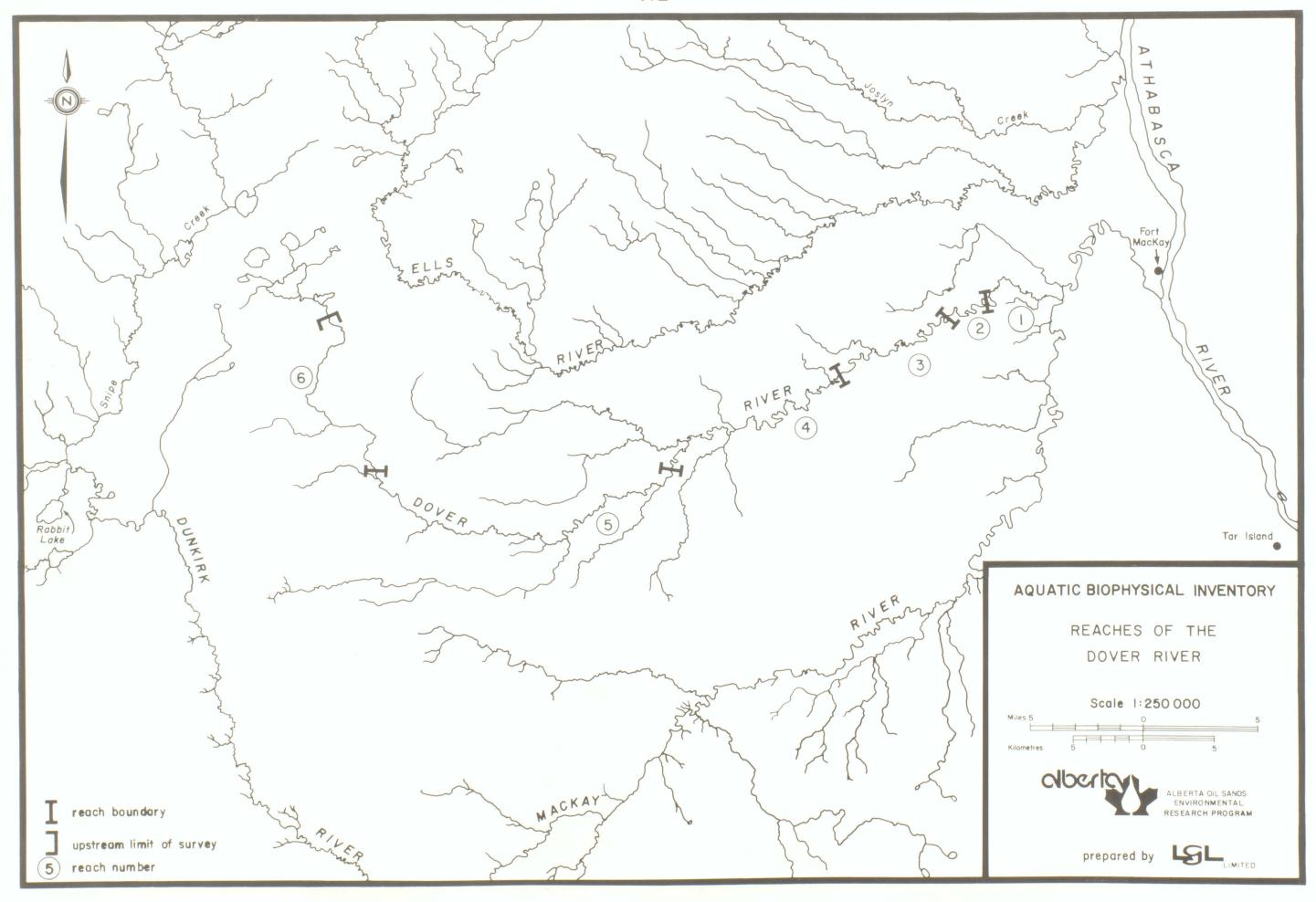


FISH COLLECTIONS





# DOVER RIVER



Species	Adults	Juveniles and Young-of-the-year	Total Numbers
longnose dace	0	3	3
longnose sucker	0	13	13
pearl dace	0	122	122
white sucker	0	1	1
Total	0	139	139

#### PHYSICAL CHARACTERISTICS

Reach length (km)	12.5
Channel width (m)	10
Channel area (ha)	12.5
Gradient (m/km)	4.1
Flow character	swirling, rolling, broken
Total pools (%)	70
Pattern	irregularly meandering
Confinement	confined
Unstable banks (%)	40
Substrate composition (%)	
fines (<2 mm)	20
gravels (2-64 mm)	40
larges (>64 mm)	35
bedrock and/or oil sand	5
Debris	moderate

#### REACH DESCRIPTION AND FISH UTILIZATION

This lower reach of the Dover River is a high gradient section that extends upstream 12.5 km from the confluence with the MacKay River. The river channel is irregularly meandering, and there is a relatively high proportion of unstable banks that consist of silt, sand and gravel. Several beaver dams were present at the time the river was surveyed in 1979. Although the gradient in this reach is relatively high and riffles are numerous, water velocities in most of the reach are moderate and a high proportion of the reach consists of pools. The substrate consists primarily of larges and coarse gravels, but there are areas with sand and fine gravel substrates. The riparian vegetation is mostly deciduous trees and shrubs, with some patches of coniferous trees. There is a relatively dense growth of grasses and little overhanging vegetation. A moderate amount of debris is present in the river channel.

The spawning potential of this reach is considered good for several species of fish that have been collected from the Dover River. The numerous riffle areas provide suitable spawning locations for some species that spawn over gravel substrates (e.g., white sucker, longnose dace). Other areas with sand and fine gravel substrates may be suitable for spawning of some of the forage fish, particularly pearl dace. Numerous shallow backwaters and the abundant shelter provided by debris and some aquatic vegetation provide very good rearing potential in this reach. Good resting and feeding locations for larger fish are provided by the numerous swirling pools. There are a number of moderately deep pools that are probably suitable for overwintering of fish.

## BENTHIC INVERTEBRATES

OLIGOCHAETA HIRUDINEA Glossiphoniidae GASTROPODA

Lymnaea PELECYPODA Musculium

ARACHNIDA Hydracarinà INSECTA

Ephemeroptera Ameletus Ephemera

Odonata

Hemiptera

Plecoptera

Corixidae Megaloptera Trichoptera

Coleoptera Elmidae Diptera Tipulidae Ceratopogonidae Chironomidae Chironominae

Tanypodinae Simuliidae Tabanidae Rhagionidae Syrphidae Ephyridae

#### RIPARIAN VEGETATION

Bank coverage (%) Coniferous trees Deciduous trees Grasses Barren Channel cover (%) Overhang Crown

#### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

#### STREAM GAUGING DATA

Water Survey of Canada station number 07DB002

0.03 m<sup>3</sup>/s (March 1977) 24.61 m<sup>3</sup>/s (April 13, 1976) Maximum daily discharge: Minimum daily discharge: 0.03 m<sup>3</sup>/s (March 3, 1977)

and Warner and Spitzer (1979).

Maximum total annual discharge: ND Minimum total annual discharge: ND Maximum annual mean discharge: Minimum annual mean discharge: 9.74 m<sup>3</sup>/s (April 1976) Maximum monthly mean discharge: Mininum monthly mean discharge:

Data for 1975 to 1977 compiled from Loeppky and Spitzer (1977)



A section of riffles at km 0.1.



Swirling pool area and large substrate material at km 8.5.

#### WATER QUALITY

Water Survey of Canada station number 00AT07DB0020

	Mean	Maximum	Minimum
Total alkalinity (mg CaCO <sub>3</sub> /1) pH	286.1 7.90	462.2 8.40	67.2 7.50
Total hardness (mg CaCO <sub>3</sub> /1)	216.7	339.4	56.9
Conductance (µS/cm)	564	920	120
Total filterable			
residue fixed (mg/1)	323	519	123
Total non-filterable residue fixed (mg/1)	17	92	2
Total organic carbon (mg C/1)	26.0	47.0	14.0
Silica (mg SiO <sub>2</sub> /1)	8.9	15.7	2.1
Nitrate and nitrite nitrogen (mg N/1)	0.140	0.500	< 0.003
Total Kjeldahl nitrogen (mg N/1)	1.24	2.12	0.50
Total Phosphorus (mg P/I)	0.090	0.300	0.030
Orthophosphate (mg P/1)	0.020	0.039	0.005
Sulphate (mg SO <sub>4</sub> /1)	31.4	83.0	6.5

Data for the period January 1976 to December 1979 obtained from the National Water Quality Data Bank (NAQUADAT).

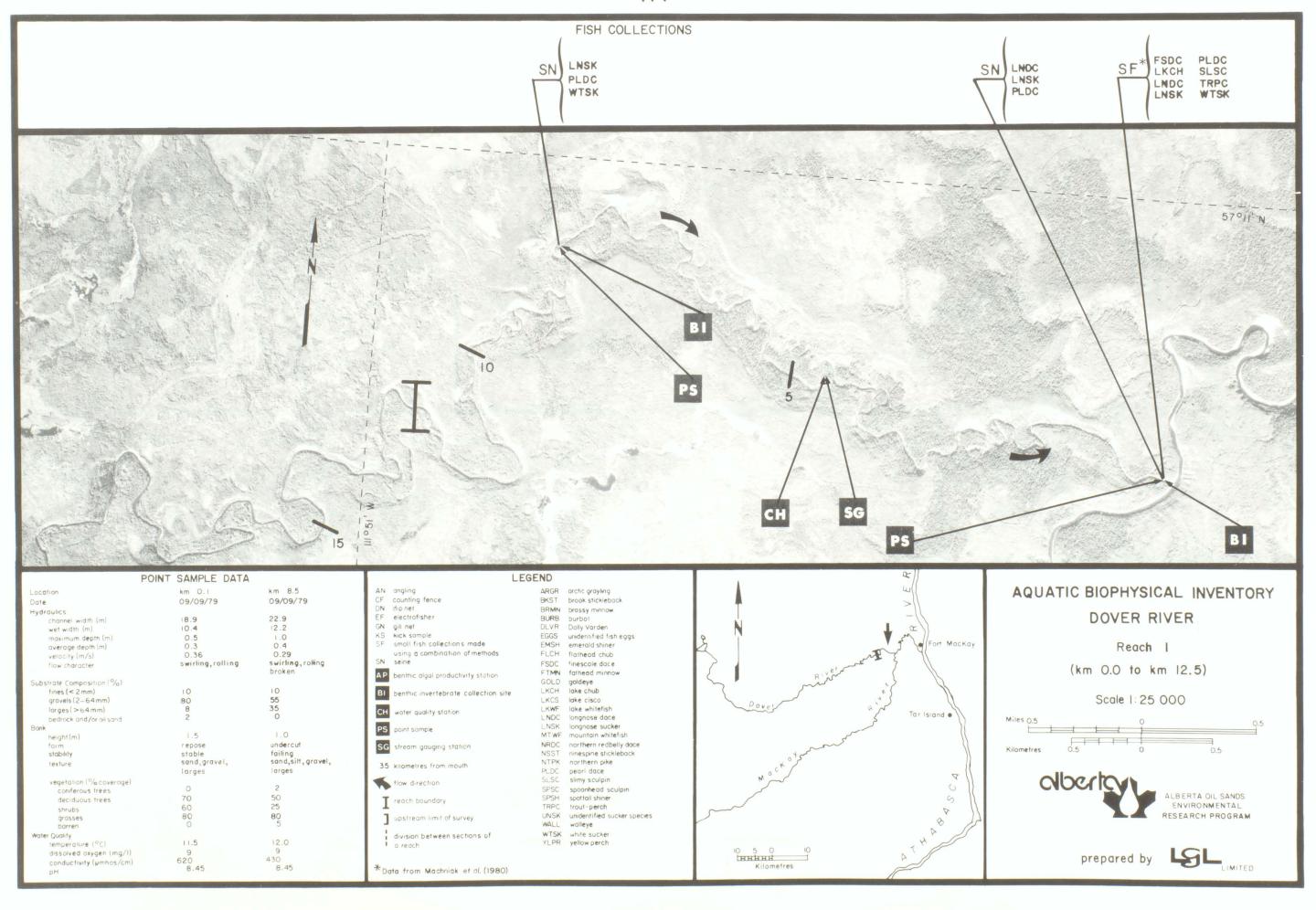
## AQUATIC BIOPHYSICAL INVENTORY DOVER RIVER

Reach I (km 0.0 to km 12.5)



ALBERTA OIL SANDS ENVIRONMENTAL RESEARCH PROGRAM





Species	Adults	Juveniles and Young-of-the-year	Total Numbers
slimy sculpin	0	3	3
white sucker	0	"1	1
Total	0	4	4

#### PHYSICAL CHARACTERISTICS

Reach length (km)	7.0
Channel width (m)	15
Channel area (ha)	10.5
Gradient (m/km)	2.2
Flow character	placid, swirling
Total pools (%)	95
Pattern	irregularly meandering
Confinement	frequently confined
Unstable banks (%)	15
Substrate composition (%)	
fines (<2 mm)	40
gravels (2-64 mm)	35
larges (>64 mm)	20
bedrock and/or oil sand	5
Debris	moderate

#### REACH DESCRIPTION AND FISH UTILIZATION

This short reach is a region of transition between Reach 3, which has a low gradient, and Reach 1, which has a steep gradient. The river channel meanders in an irregular pattern and there are a few areas with high, unstable banks. These banks appear to be composed of silt, sand and gravel. Exposed oil sands deposits are also evident in some places. Although the gradient is moderate, the flow is mostly placid and slow due to the large number of beaver dams in this reach. There are high proportions of silt and sand in the substrate, but gravels and larges are also abundant, particularly downstream from beaver dams. The riparian vegetation is dominated by deciduous trees and shrubs, but there are some scattered patches of conifers. Grasses are abundant and there is some overhanging vegetation in most areas. There is a moderate amount of debris in the river channel.

The potential of this reach for spawning of the larger fish species is considered low; suitable substrates and riffle areas are not abundant, and the beaver dams probably severely limit upstream movement of the larger fish. The small gravelly areas downstream from beaver dams may be suitable for spawning of some forage fish species (e.g., pearl dace, trout-perch, slimy sculpin). Some suckers may also spawn in this reach. The shallow backwaters, abundant debris, and overhanging vegetation provide very good rearing habitat, and the deep beaver impoundments are suitable overwintering areas for forage fish and possibly suckers.

# BENTHIC INVERTEBRATES

OLIGOCHAETA HIRUDINEA GASTROPODA Ferrissia

Gyraulus PELECYPODA Musculium

Sphaerium INSECTA

Ephemeroptera Ameletus Caenis

Stenonema Odonata

Ophiogomphus Trichoptera Brachycentrus Helicopsyche

Oecetis Coleoptera Elmidae Diptera Tipulidae Chironomidae Tanypodinae Tabanidae Rhagionidae Atherix

Dolichopodidae

#### RIPARIAN VEGETATION

Bank coverage (%) Coniferous trees Deciduous trees Shrubs Grasses Barren Channel cover (%) Overhang Crown

#### BENTHIC ALGAL PRODUCTIVITY

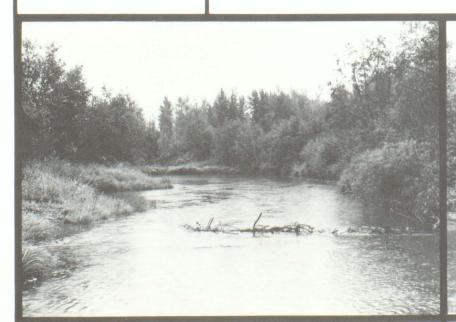
No data available for this reach

#### STREAM GAUGING DATA

No data available for this reach

#### WATER QUALITY

No data available for this reach



Placid and swirling pool area at km 15.9 is representative of reach 2.

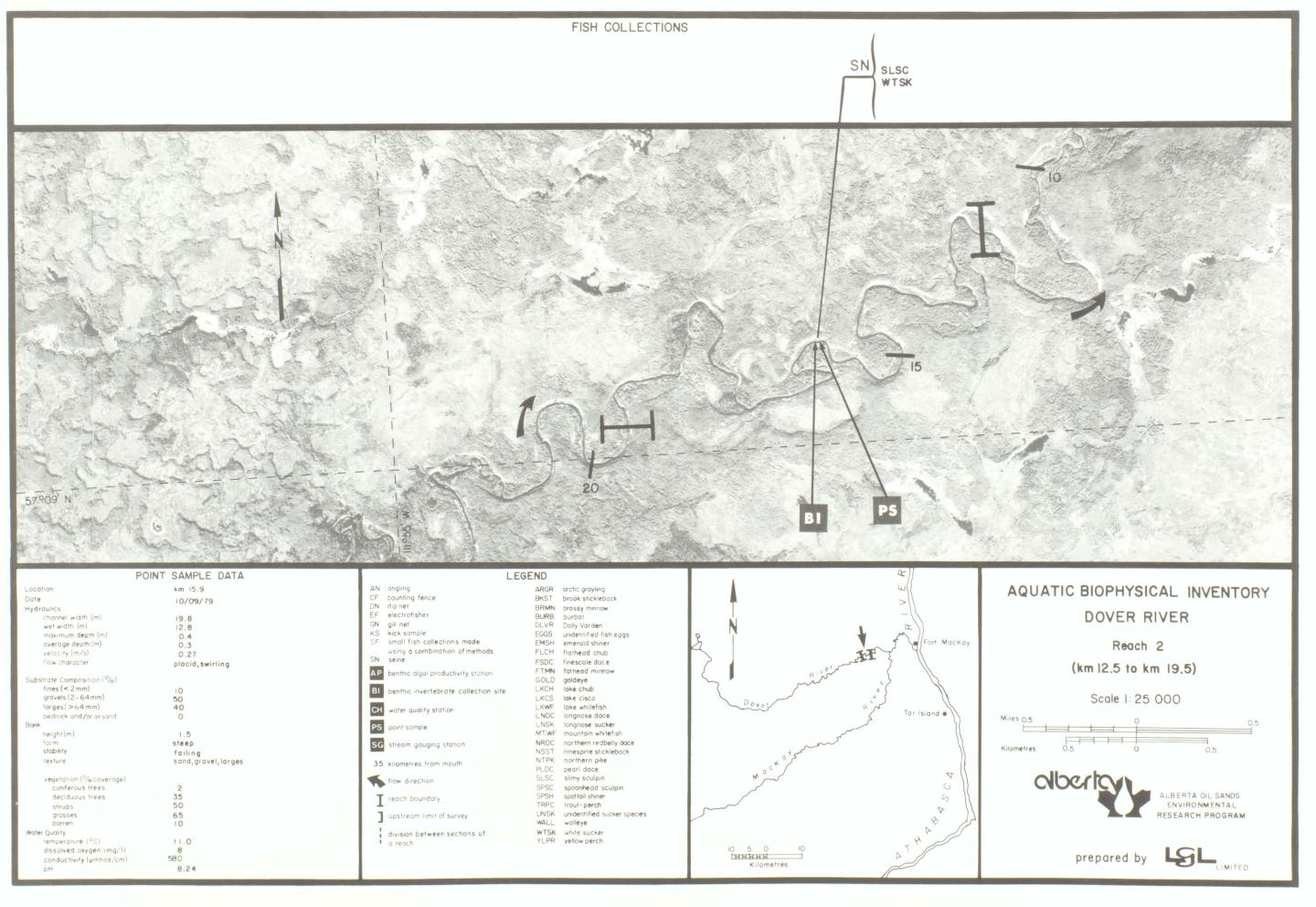
Dover River at km 15.9.

## AQUATIC BIOPHYSICAL INVENTORY DOVER RIVER

Reach 2 (km 12.5 to km 19.5)







Species	Adults	Juveniles and Young-of-the-year	Total Number
northern pike	0	1	1
trout-perch	0	2	2
white sucker	0	5	5
Total	0	8	8

#### PHYSICAL CHARACTERISTICS

Reach length (km)	19.7
Channel width (m)	20
Channel area (ha)	39.4
Gradient (m/km)	0.9
Flow character	placid
Total pools (%)	100
Pattern	irregularly meandering
Confinement	occasionally confined
Unstable banks (%)	5
Substrate composition	on (%)
fines (<2 mm)	95
gravels (2-64 mm)	5
larges (>64 mm)	0
bedrock and/or oi	l sand 0
Debris	moderate

#### REACH DESCRIPTION AND FISH UTILIZATION

This section of the Dover River meanders in an irregular pattern through an area of treed muskeg. The gradient is low and the reach is virtually all placid pools. Beaver dams are very numerous. The substrate is almost entirely sand and silt with some organic detritus, but there are some small areas with gravel substrates immediately downstream from beaver dams. The river banks are stable and well vegetated. The riparian vegetation is dominated by deciduous shrubs and a dense growth of grasses. Deciduous trees are also numerous, but only scattered patches of conifers are present. In most areas, some grasses and shrubs overhang the river channel. Debris in the river channel, most of which appears to be the result of beaver activity, is moderate.

Because the numerous beaver dams are certain to severely limit the movement of larger fish and because areas with gravel substrates are few, the spawning potential for most of the larger fish species is considered to be poor. There are many areas, however, that appear to be suitable for spawning of those forage fish that will spawn over sandy substrates (e.g., pearl dace, trout-perch). Some spawning of suckers may also occur in this reach and the moderate amounts of aquatic vegetation may provide some spawning areas for brook stickleback and northern pike. The numerous weedy shallows, abundant debris, and overhanging vegetation provide good rearing areas in this reach. Juvenile northern pike, trout-perch and white sucker were collected here. The deep ponds formed behind beaver dams provide good overwintering areas.

#### BENTHIC INVERTEBRATES NEMATODA

OLIGOCHAETA GASTROPODA

PELECYPODA CRUSTACEA

Cladocera Daphnia sp.

Amphipoda

INSECTA Ephemeroptera

Baetis Ephemera

Paraleptophlebia

Odonata

Hemiptera Corixidae Megaloptera

Trichoptera

Nemotaulius Ptilostomis Coleoptera

Dytiscidae Gyrinidae Flmidae Chrysomelidae

Donacia Diptera Chironomidae Chironominae Tanypodinae

#### RIPARIAN VEGETATION

Crown

Bank coverage (%) Coniferous trees Deciduous trees 30 Shrubs Grasses Barren Channel cover (%) Overhang

#### BENTHIC ALGAL PRODUCTIVITY

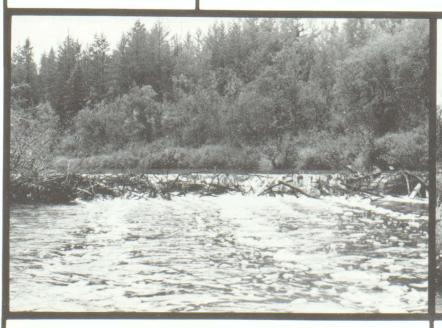
No data available for this reas+

#### STREAM GAUGING DATA

No data available for this reach

#### WATER QUALITY

No data available for this reach



Beaver dam at km 31.5.

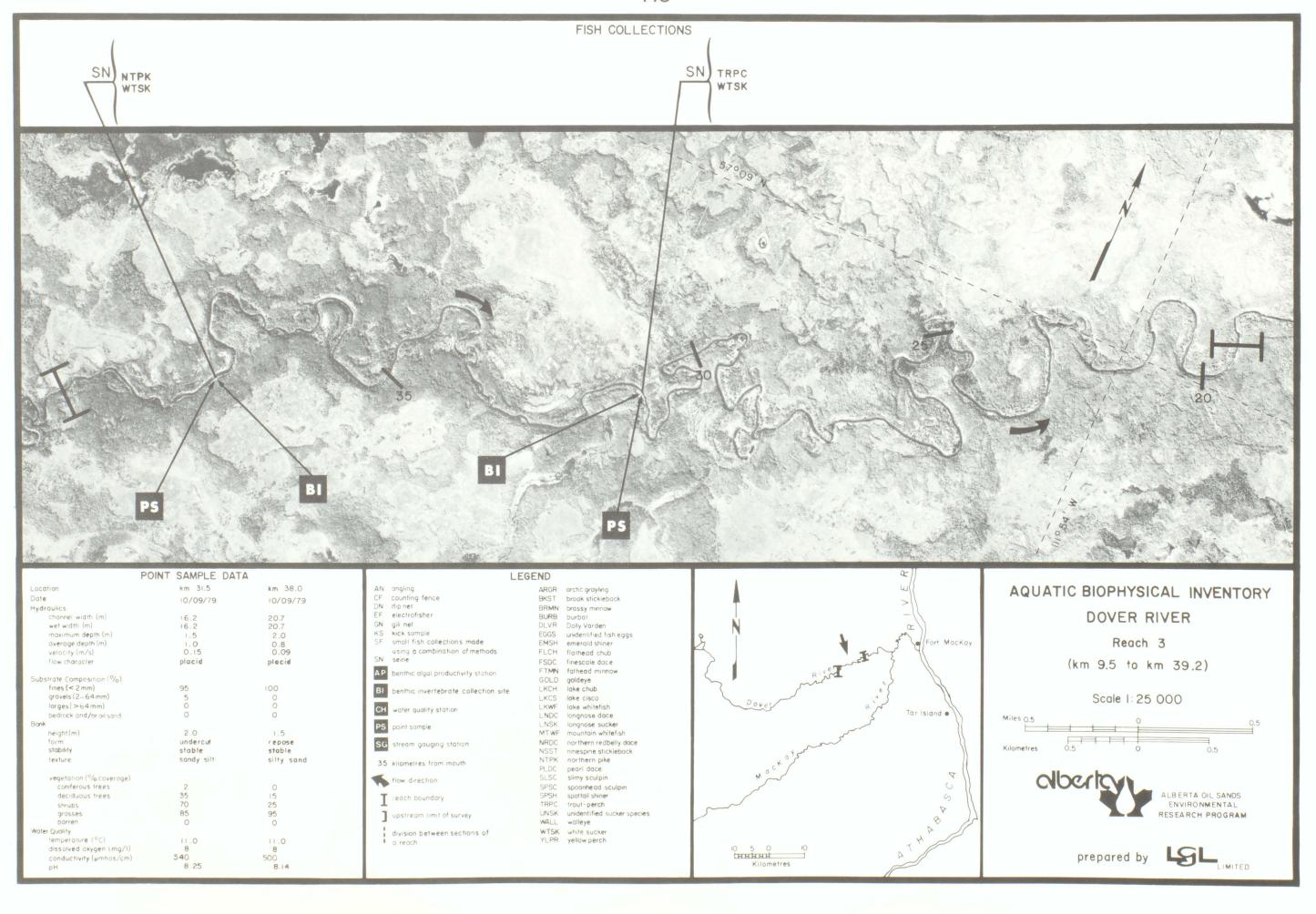
Pool upstream of beaver dam at km 31.5.

## AQUATIC BIOPHYSICAL INVENTORY DOVER RIVER

Reach 3 (km 19.5 to km 39.2)







Species	Adults	Juveniles and Young-of-the-year	Total Numbers
pearl dace	0		1
slimy sculpin	0	3	3
white sucker	0	1	1
Total	_		<del>-</del> 5

#### PHYSICAL CHARACTERISTICS

Reach length (km)	36.8
Channel width (m)	14
Channel area (ha)	51.5
Gradient (m/km)	1.0
Flow character	placid, swirling
Total pools (%)	100
Pattern	tortuously meandering
Confinement	unconfined
Unstable banks (%)	5
Substrate composition (%)	
fines (<2 mm)	60
gravels (2-64 mm)	40
larges (>64 mm)	0
bedrock and/or oil sand	0
Debris	high

#### REACH DESCRIPTION AND FISH UTILIZATION

This tortuously meandering reach has a low gradient similar to that of Reach 3, and the entire reach consists of slowly flowing pools. Beaver dams are numerous, although not as abundant as in Reach 3. The stream is fairly deep and the banks are undercut and stabilized by vegetation. The substrate consists of silt and sand throughout much of the reach, but areas with sand and fine gravel substrates are fairly numerous. The riparian vegetation consists of deciduous shrubs and trees with scattered patches of conifers. There is also a dense growth of grasses. Shrubs and grasses overhang the river channel throughout the reach and there are large amounts of debris in the channel.

The areas with sand and gravel substrates in this reach may provide suitable spawning areas for several of the forage fish species that have been collected here (e.g., lake chub, pearl dace, trout-perch, slimy sculpin). Longnose suckers and white suckers have been collected in this reach and some spawning of these species may also occur in the reach. Several areas with low to moderate amounts of aquatic vegetation are probably suitable for spawning of brook stickleback. The large amounts of debris, undercut banks, and overhanging vegetation provide abundant rearing areas. The water depth is probably sufficient to allow overwintering of fish.

## BENTHIC INVERTEBRATES GASTROPODA

Gyraulus PELECYPODA Musculium Sphaerium CRUSTACEA Cladocera

INSECTA Ephemeroptera Baetisca Ephemera Ephemerella Paraleptophlebia Parameletus Stenonema Plecoptera

Hemiptera Corixidae Megaloptera

Trichoptera Arctopsyche Oecetis

Polycentropus Diptera Chironomidae Chironominae Tabanidae

#### RIPARIAN VEGETATION

Bank coverage (%) 10 Coniferous trees 50 Deciduous trees 65 Shrubs Grasses Barren Channel cover (%) Overhang Crown

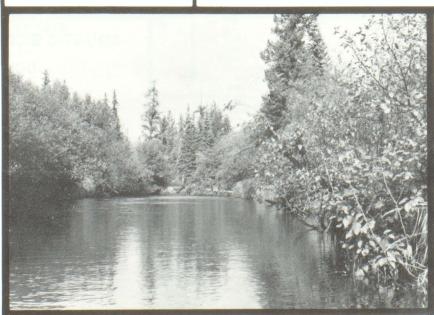
#### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

#### STREAM GAUGING DATA

No data available for this reach

No data available for this reach



Placid flow and overhanging bank vegetation at km 47.5 are typical of reach 4.

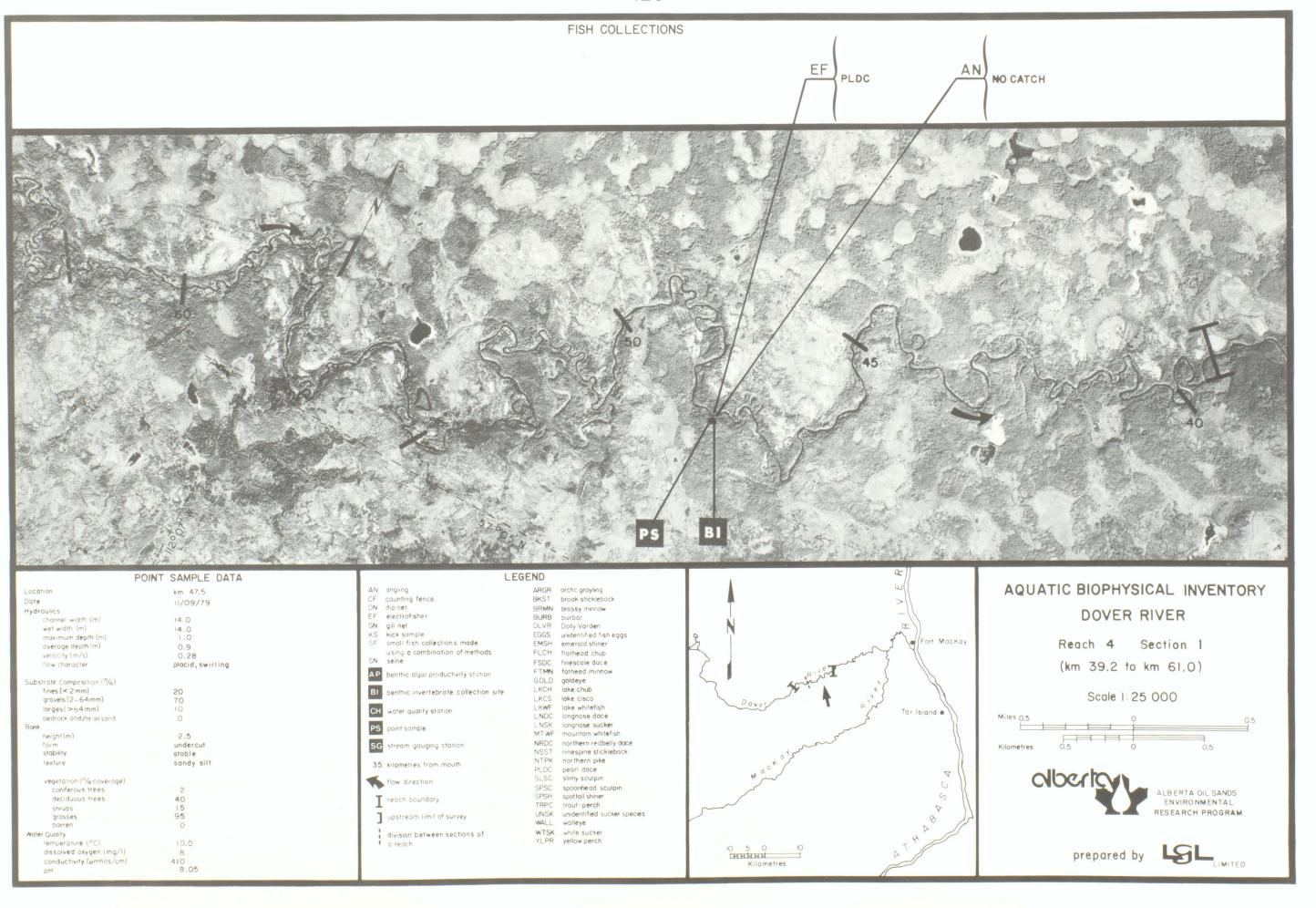
Dover River at km 63.

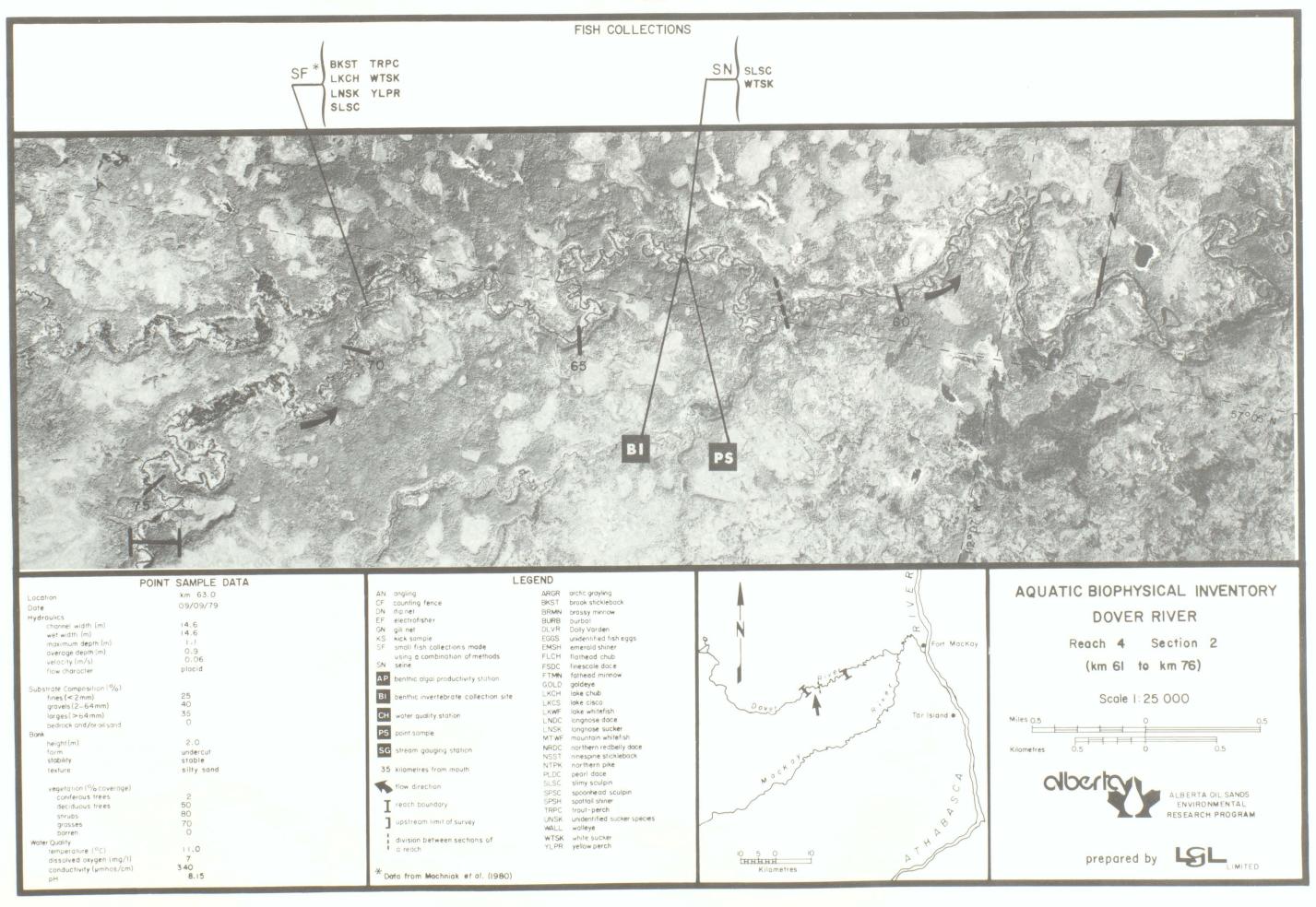
## AQUATIC BIOPHYSICAL INVENTORY DOVER RIVER

Reach 4 (km 39.2 to km 76.0)









Species	Adults	Juveniles and Young-of-the-year	Total Numbers
pearl dace	0	4	4
	_		_
Total	0	4	4

#### PHYSICAL CHARACTERISTICS

Reach length (km)	56.5
Channel width (m)	7
Channel area (ha)	39.6
Gradient (m/km)	1.6
Flow character	placid, swirling
Total pools (%)	100
Pattern	tortuously meandering
Confinement	occasionally confined
Unstable banks (%)	2
Substrate composition (%)	
fines (<2 mm)	95
gravels (2-64 mm)	5
larges (>64 mm)	0
bedrock and/or oil sand	0
Debris	high

#### REACH DESCRIPTION AND FISH UTILIZATION

This section of the Dover River meanders in a tortuous pattern through an area of muskeg. The gradient is fairly low, but somewhat steeper than the gradient in Reaches 3 and 4. Beaver dams are fairly numerous and the reach is entirely pools. The river banks are undercut, but are stabilized by vegetation. The substrate is almost entirely silt and sand, with only a few small areas of sand and gravel. Organic detritus is also abundant in the substrate material. The riparian vegetation consists of a mixture of deciduous trees, coniferous trees, and deciduous shrubs. There is also a dense growth of grasses. Much of the river channel is covered by overhanging shrubs and trees. There are large amounts of woody debris in the channel and many places where dead trees have

This reach does not contain areas suitable for spawning of most fish species that occur in the Dover River. There are some areas with aquatic vegetation that may be suitable for brook stickleback spawning. Pearl dace may also spawn over some of the sandy substrates in this reach. The rearing potential is good due to the large amounts of debris, undercut banks, and abundant overhanging vegetation. Water depths are probably sufficient for overwintering of fish.

### BENTHIC INVERTEBRATES

OLIGOCHAETA GASTROPODA PELECYPODA Musculium INSECTA Ephemeroptera Paraleptophlebia Diptera Ceratopogonidae Chironomidae Chironominae Tanypodinae Tabanidae

#### RIPARIAN VEGETATION

Crown

Bank coverage (%) Coniferous trees Deciduous trees Shrubs Grasses Barren Channel cover (%) Overhang

#### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

#### STREAM GAUGING DATA

No data available for this reach

#### WATER QUALITY

No data available for this reach



Slow-moving pool and overhanging bank vegetation at km 86 are representative of reach 5.



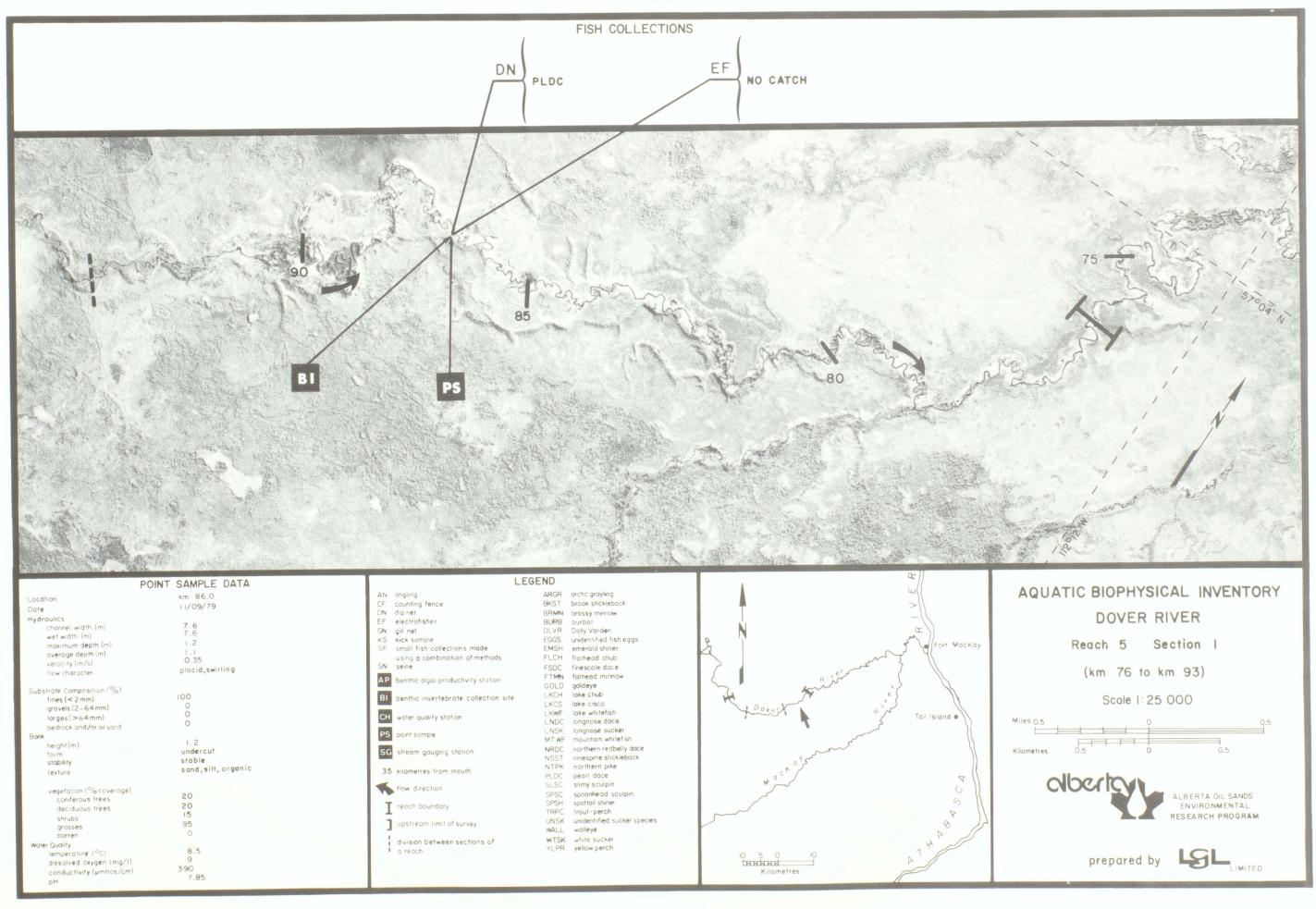
Abundant debris at km 86 is typical of this reach.

AQUATIC BIOPHYSICAL INVENTORY DOVER RIVER

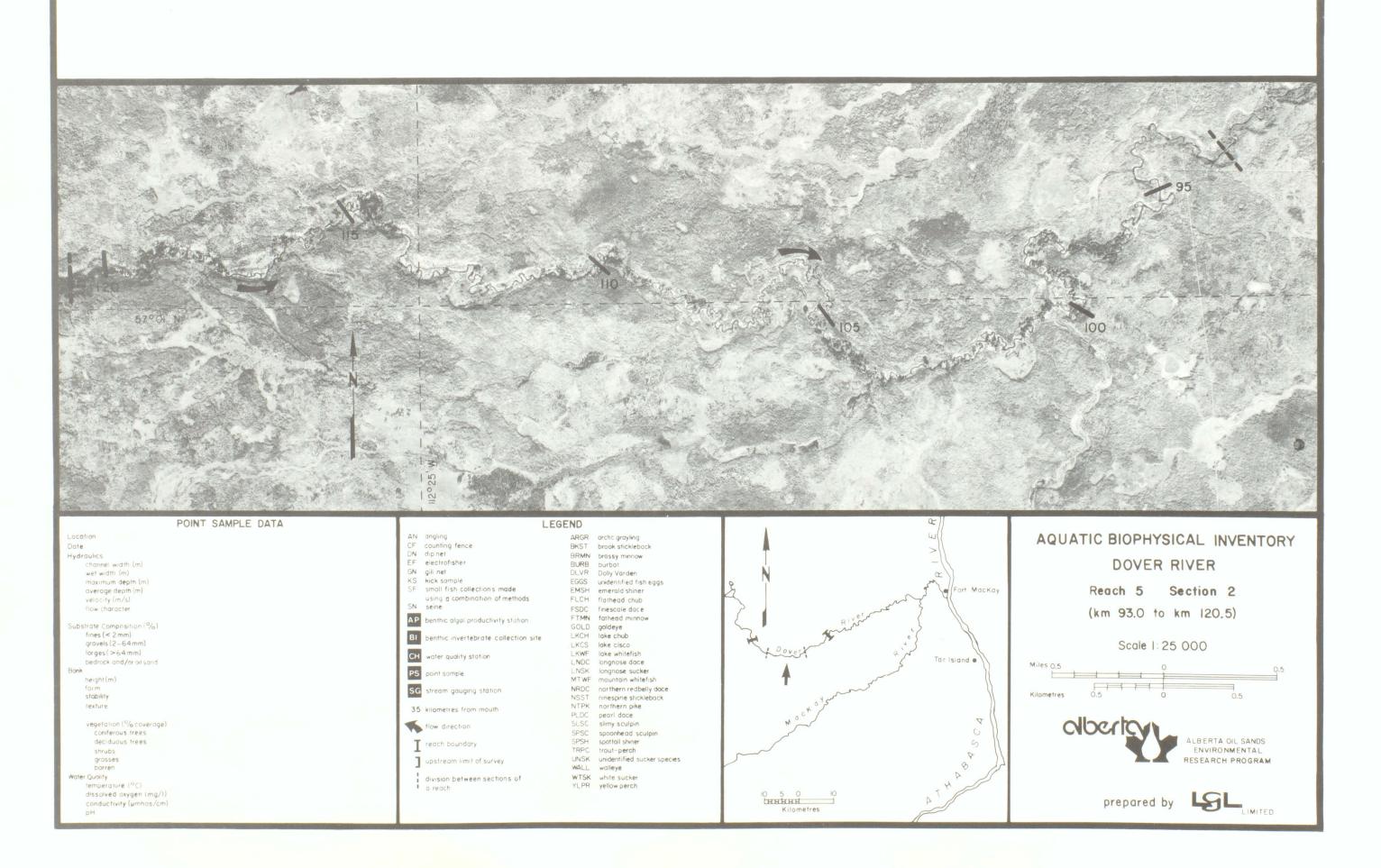
> Reach 5 (km 76.0 to km 132.5)









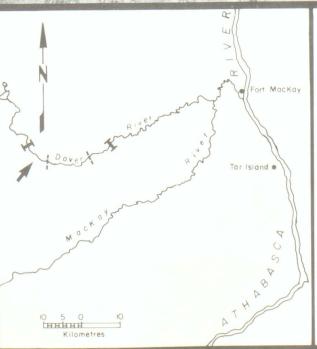






#### Location Date Hydraulics channel width (m) wet width (m) maximum depth (m) average depth (m) velocity (m/s) flow character Substrate Composition (%) fines (< 2 mm) gravels (2-64 mm) larges(>64mm) bedrock and/or oil sand stability vegetation (% coverage) coniferous trees deciduous trees shrubs grasses barren Water Quality temperature (°C) dissolved oxygen (mg/l) conductivity (µmhos/cm)

#### AN angling CF counting fence DN dip net EF electrofisher ARGR arctic grayling BKST brook stickleback BRMN brassy minnow BURB burbot DLVR Dolly Varden GN gill net KS kick sample SF small fish collections made EGGS unidentified fish eggs EMSH emerald shiner using a combination of methods SN seine FLCH flathead chub FSDC finescale dace AP benthic algal productivity station FTMN fathead mingow GOLD goldeye LKCH lake chub BI benthic invertebrate collection site LKCS lake cisco CH water quality station LKWF lake whitefish LNDC longnose dace LNSK longnose sucker MTWF mountain whitefish PS point sample NRDC northern redbelly dace SG stream gauging station NSST ninespine stickleback NTPK northern pike 35 kilometres from mouth PLDC pearl dace SLSC slimy sculpin flow direction SPSC spoonhead sculpin SPSH spottail shiner TRPC trout-perch T reach boundary UNSK unidentified sucker species upstream limit of survey WALL walleye WTSK white sucker YLPR yellow perch division between sections of



## AQUATIC BIOPHYSICAL INVENTORY DOVER RIVER

Reach 5 Section 3 (km 120.5 to km 132.5)

Scale 1: 25 000





ALBERTA OIL SANDS ENVIRONMENTAL RESEARCH PROGRAM



Species	Adults	Juveniles and Young-of-the-year	Total Numbers
brook stickleback	9	7	16
	_	_	
Total	9	7	16

#### PHYSICAL CHARACTERISTICS

Reach length (km)	21.5
Channel width (m)	75
Channel area (ha)	161.3
Gradient (m/km)	1.8
Flow character	placid
Total pools (%)	100
Pattern	irregular
Confinement	unconfined
Unstable banks (%)	0
Substrate composition (%)	
fines (<2 mm)	95
gravels (2-64 mm)	5
larges (>64 mm)	0
bedrock and/or oil sand	0
Debris	moderate

#### REACH DESCRIPTION AND FISH UTILIZATION

This reach is a long marshy section in a muskeg region. The gradient is low and the stream flow is very slow. Many beaver dams are present throughout this reach. The substrate consists almost entirely of sand, silt, and organic detritus, but there are a few areas with fine gravel substrates. The riparian vegetation is primarily grasses and deciduous shrubs, but there are also some deciduous and coniferous trees. There is a relatively large amount of overhanging vegetation and moderate amounts of debris in the river channel.

The abundant aquatic vegetation in this reach provides good spawning potential for brook stickleback and possibly northern pike (only brook stickleback were collected from this reach). Spawning potential for other species is considered poor, but some forage species (e.g., pearl dace) may be able to spawn successfully in this reach. Rearing potential is considered good because ample cover is provided by log debris and aquatic vegetation. Water depths are probably sufficient to allow overwintering of fish.

### BENTHIC INVERTEBRATES

OLIGOCHAETA CRUSTACEA Cladocera Amphipoda INSECTA Ephemeroptera Diptera Chironomidae Chironominae

Orthocladiinae

#### RIPARIAN VEGETATION

Bank coverage (%) Coniferous trees Deciduous trees Grasses Barren Channel cover (%) Overhang Crown

#### BENTHIC ALGAL PRODUCTIVITY

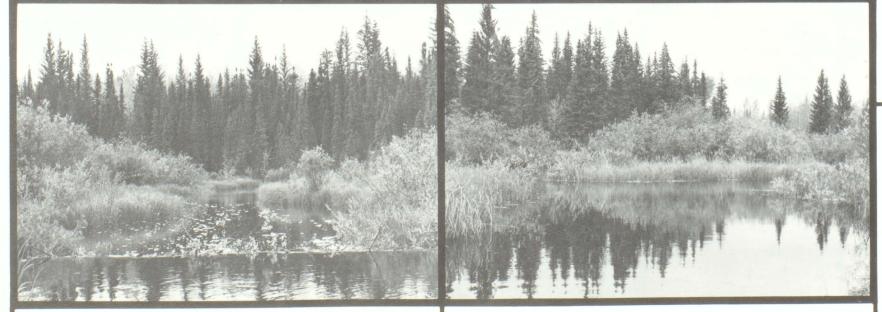
No data available for this reach

#### STREAM GAUGING DATA

No data available for this reach

#### WATER QUALITY

No data available for this reach



Beaver dam on Dover River at km 134.5.

Large pond behind beaver dam at km 134.5.

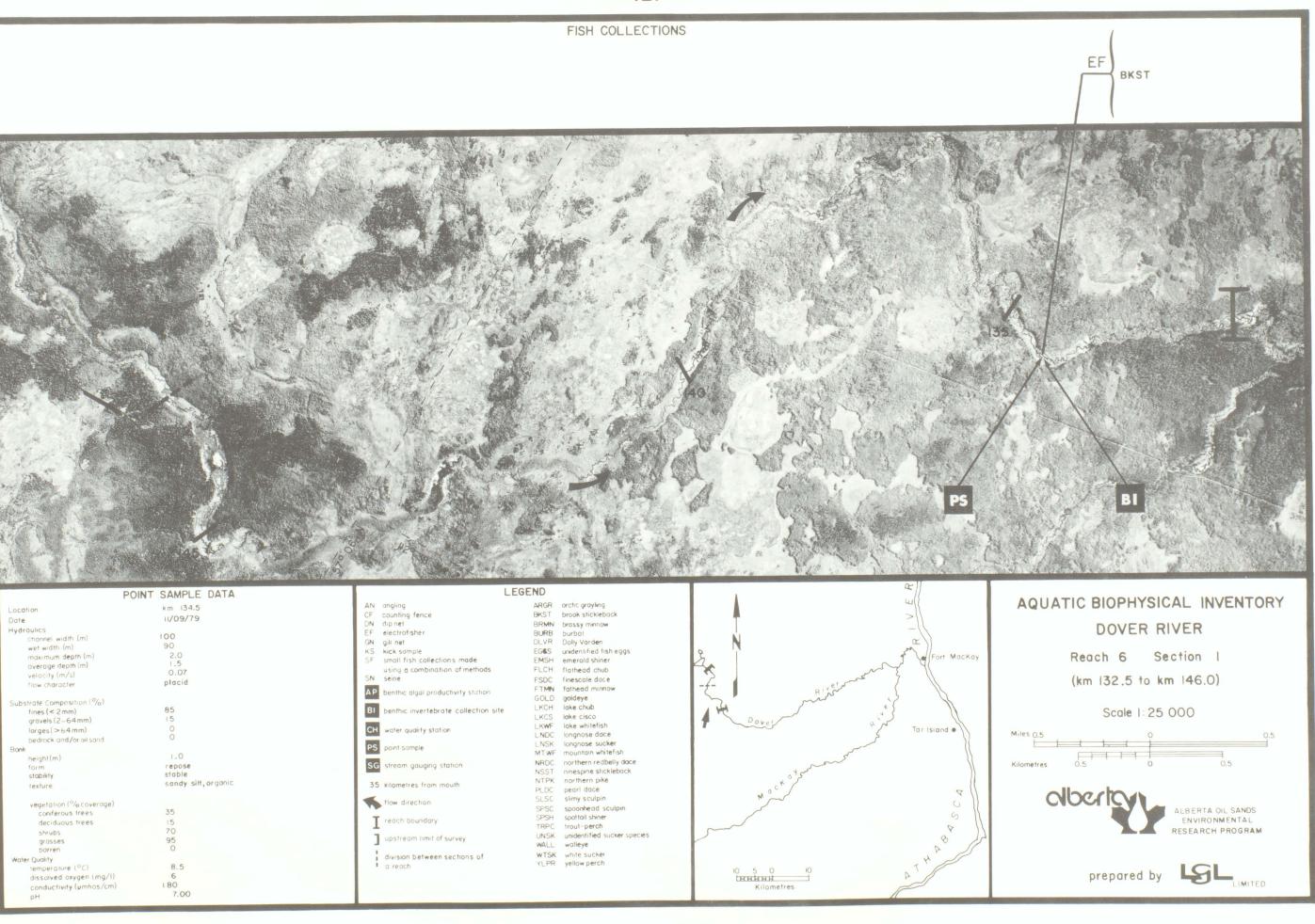
# AQUATIC BIOPHYSICAL INVENTORY DOVER RIVER

Reach 6 (km | 32.5 to km | 154.0)

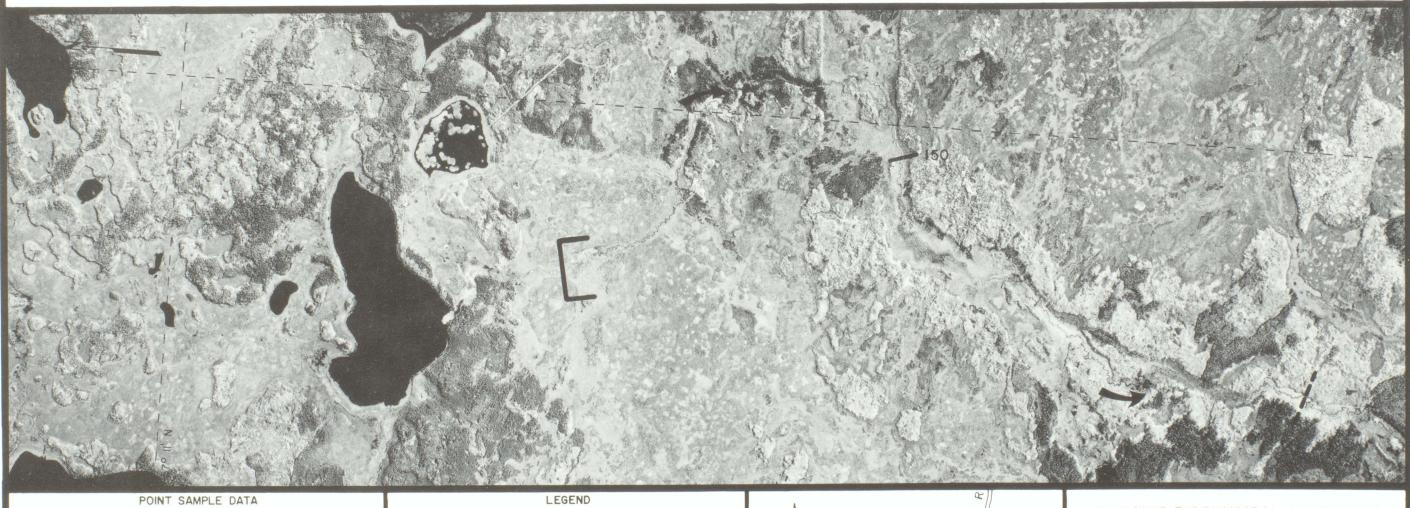


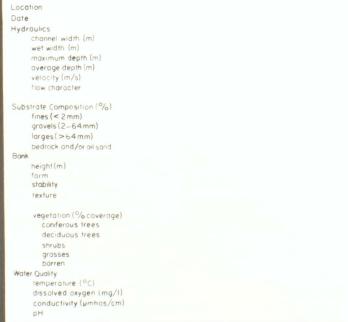
ENVIRONMENTAL RESEARCH PROGRAM



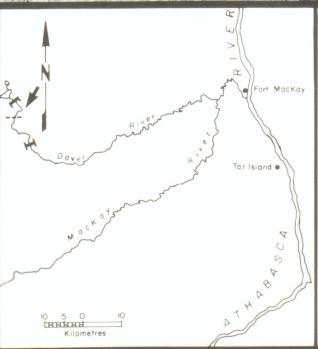


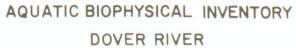
FISH COLLECTIONS





#### AN angling CF counting fence DN dip net EF electrofisher ARGR arctic grayling BKST brook stickleback BRMN brassy minnow BURB burbot GN gill net DLVR Dolly Varden KS kick sample SF small fish collections made EGGS unidentified fish eggs EMSH emerald shiner using a combination of methods FLCH flathead chub SN seine FSDC finescale dace FTMN fathead minnow AP benthic algal productivity station GOLD goldeye LKCH lake chub LKCS lake cisco LKWF lake whitefish BI benthic invertebrate collection site CH water quality station LNDC longnose dace LNSK longnose sucker MTWF mountain whitefish PS point sample NRDC northern redbelly dace NSST ninespine stickleback SG stream gauging station NTPK northern pike 35 kilometres from mouth PLDC pearl dace SLSC slimy sculpin flow direction SPSC spoonhead sculpin SPSH spotfall shiner TRPC trout-perch UNSK unidentified sucker species T reach boundary upstream limit of survey WALL walleye WTSK white sucker YLPR yellow perch division between sections of a reach





Reach 6 Section 2 (km 146 to km 154)



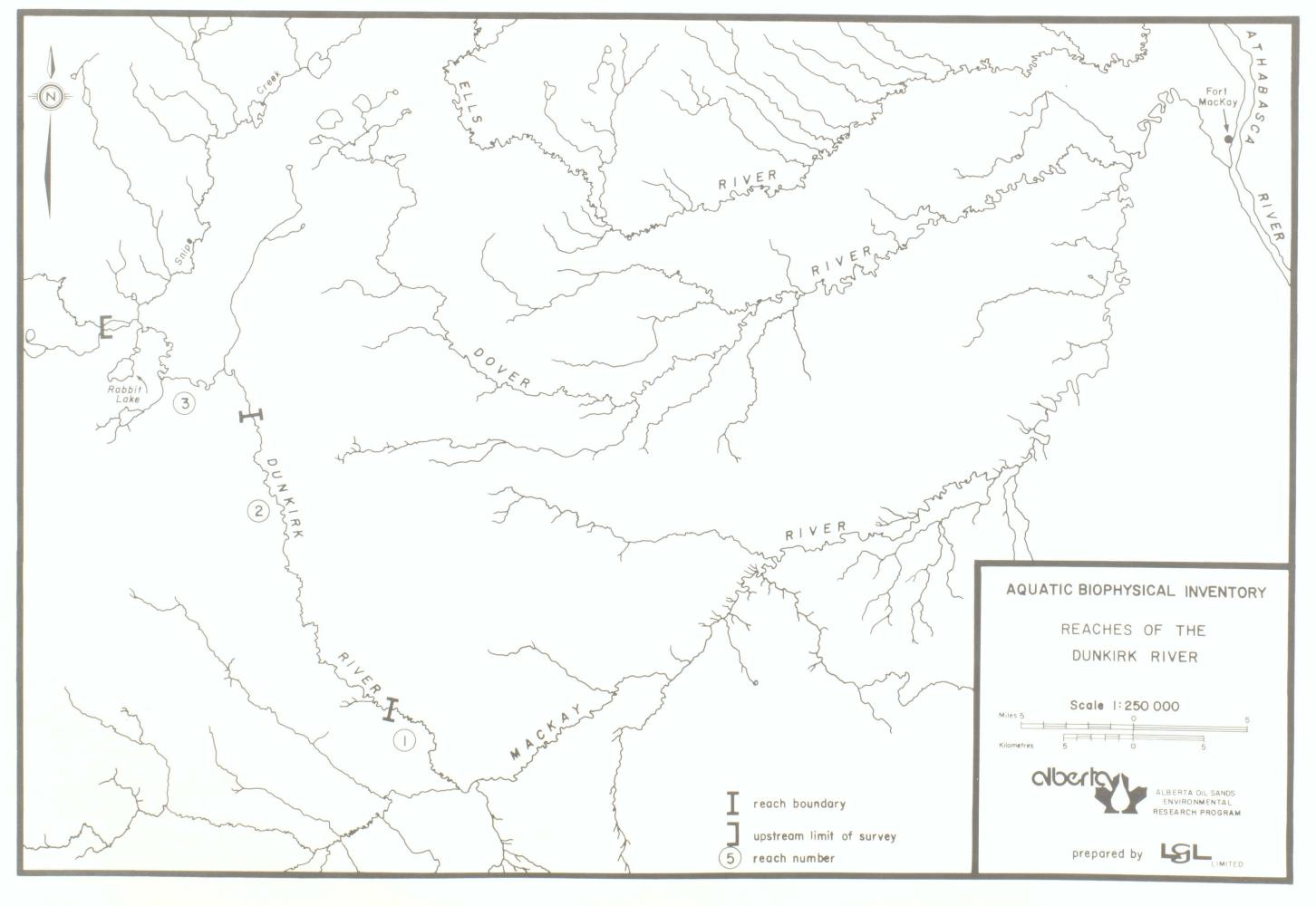




ALBERTA OIL SANDS ENVIRONMENTAL RESEARCH PROGRAM



# DUNKIRK RIVER



Species	Adults	Juveniles and Young-of-the-year	Total Numbers
brook stickleback	3	0	3
northern pike	0	1	1
pearl dace	0	11	11
trout-perch	<i>L</i> <sub>4</sub>	6	10
white sucker	0	11	11
Total	7	29	36

#### PHYSICAL CHARACTERISTICS

Reach length (km)	16.5
Channel width (m)	17
Channel area (ha)	28.1
Gradient (m/km)	0.4
Flow character	placid
Total pools (%)	100
Pattern	tortuously meandering
Confinement	unconfined
Unstable banks (%)	0
Substrate composition (%)	
fines (<2 mm)	100
gravels (2-64 mm)	0
larges (>64 mm)	0
bedrock and/or oil sand	0
Debris	high

#### REACH DESCRIPTION AND FISH UTILIZATION

This lower reach of the Dunkirk River is a tortuously meandering section that flows through an area of treed muskeg. The gradient is very low and the entire reach is a placid pool area. The substrate consists of sand and silt with a fairly high content of organic detritus. Deciduous shrubs and trees dominate the riparian vegetation, but conifers are also abundant in some areas. There is also a very dense growth of grasses. Shrubs and grasses overhang the river channel throughout most of the reach. Debris in the river channel is abundant and there are many locations where trees have fallen into or across the river.

Aquatic vegetation is fairly abundant in this reach and provides very good spawning habitat for northern pike and brook stickleback. The spawning potential for other species is poor, but some forage fish species that will spawn over sandy substrates may spawn successfully at some locations in this reach. Low water velocities, and the ample shelter provided by debris and aquatic vegetation create an excellent rearing habitat for northern pike, brook stickleback, and other forage species. The presence of juvenile white suckers indicates that the area is also suitable for rearing of that species. Water depths appear to be sufficient to allow overwintering of fish in at least the lower portion of the reach.

#### BENTHIC INVERTEBRATES

OLIGOCHAETA HIRUDINEA Glossiphoniidae GASTROPODA CRUSTACEA Amphipoda INSECTA

Ephemeroptera Odonata

Aeshnidae Plecoptera Hemiptera Corixidae Gerridae Trichoptera Coleoptera Noteridae Elmidae Diptera Tipulidae Ceratopogonidae Chironomidae Chironominae

Tanypodinae

Tabanidae Empididae

#### RIPARIAN VEGETATION

Bank coverage (%) 25 45 Coniferous trees Deciduous trees Grasses Barren Channel cover (%) Overhang

#### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

#### STREAM GAUGING DATA

No data available for this reach



Placid pool conditions, typical of this reach, at km 4.5.



Slumping, undercut bank at km 14.2.

#### WATER QUALITY

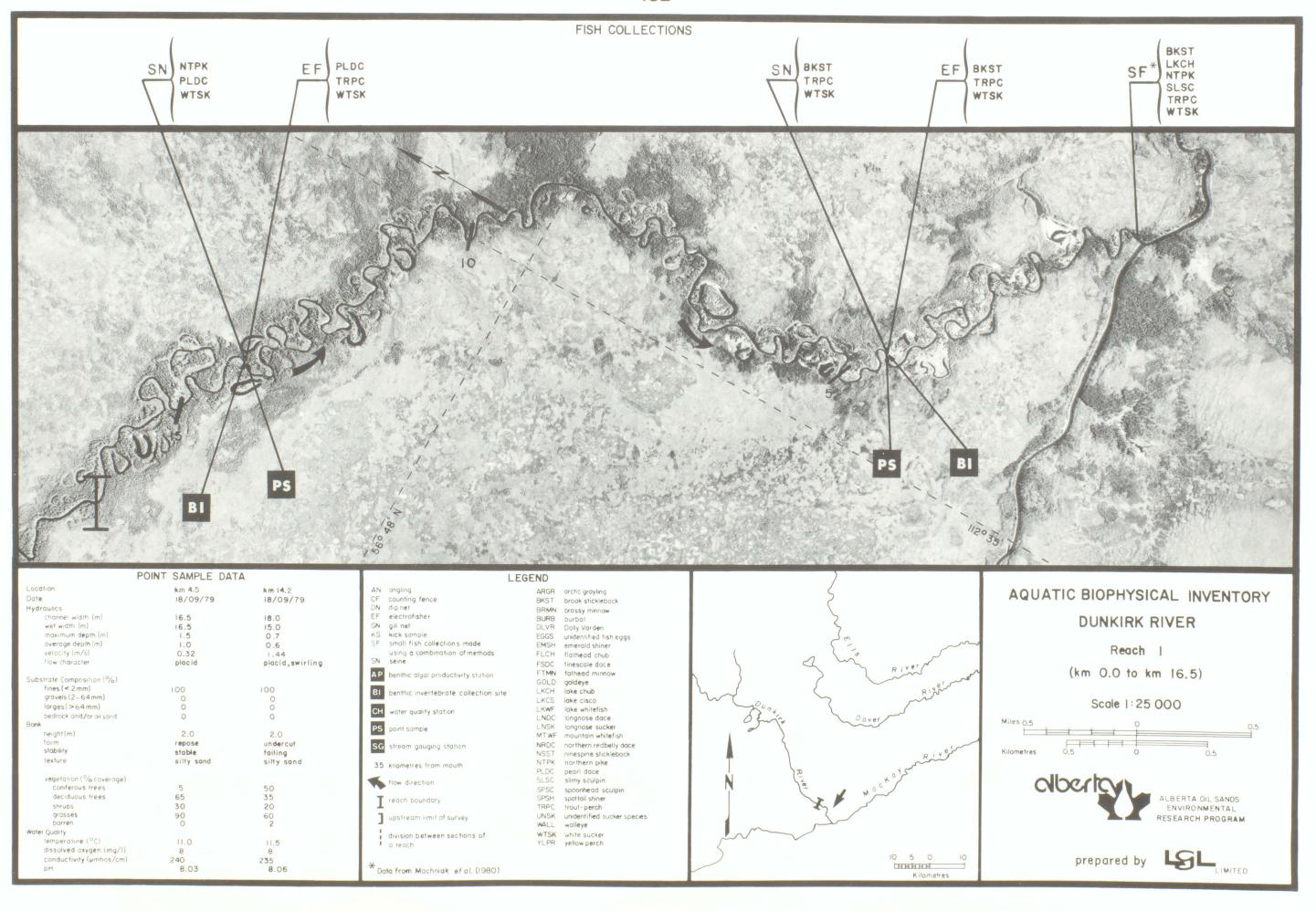
No data available for this reach

## AQUATIC BIOPHYSICAL INVENTORY DUNKIRK RIVER

Reach | (km 0 to km 16)







Species	Adults	Juveniles and Young-of-the-year	Total Numbers
brook stickleback	2	0	2
longnose sucker	0	1	1
northern pike	0	3	3
pearl dace	12	40	52
slimy sculpin	3	0	3
trout-perch	4	3	7
white sucker	0	2	2
Total	21	49	70

#### PHYSICAL CHARACTERISTICS

Reach length (km)	39.7
Channel width (m)	22
Channel area (ha)	87.3
Gradient (m/km)	0.9
Flow character	placid, swirling, rollin
Total pools (%)	90
Pattern	irregularly meandering
Confinement	occasionally confined
Unstable banks (%)	5
Substrate composition (%)	
fines (<2 mm)	50
gravels (2-64 mm)	30
larges (>64 mm)	20
bedrock and/or oil sand	0
Debris	high

#### REACH DESCRIPTION AND FISH UTILIZATION

This irregularly meandering section of the Dunkirk River has a slightly steeper gradient than Reach 1. Although most of the reach consists of pools with placid and swirling flow, there are some riffle areas. Beaver dams are fairly numerous in this reach. The substrate consists mainly of sand and gravel with some cobbles and boulders. Towards the upper end of the reach, the substrate is composed of more silt and sand and less gravel than in the lower portion of the reach. The river banks are generally stable and well vegetated. The riparian vegetation is a mixture of coniferous trees, deciduous trees, and deciduous shrubs. There is also a dense growth of grasses. Moderate amounts of shrubs and grasses overhang the river channel and there are large amounts of woody debris in the channel.

The gravel and sand substrates present in this reach provide areas that appear to be suitable for spawning of arctic grayling, longnose sucker, white sucker, slimy sculpin, lake chub, trout-perch, and pearl dace. The rearing potential of this reach is very good, due to the many areas with low water velocities and abundant shelter (provided by debris and some aquatic vegetation). The pools in this reach are moderately deep and many of them are probably suitable for overwintering of fish.

WATER QUALITY

Total alkalinity (mg CaCO<sub>3</sub>/1)

Total hardness (mg CaCO<sub>3</sub>/1)

otal organic carbon (mg C/I)

otal Phosphorus (mg P/1)

rthophosphate (mg P/1)

Nitrate and nitrite nitrogen (mg N/1)

otal Kjeldahl nitrogen (mg N/1)

Conductance (uS/cm)

Total non-filterable

Silica (mg SiO<sub>2</sub>/1)

ulphate (mg SO<sub>4</sub>/1)

residue fixed (mg/1)

residue fixed (mg/1)

Total filterable

## BENTHIC INVERTEBRATES HIRUDINEA GASTROPODA

PELECYPODA

Sphaerium ARACHNIDA Hydracarina

INSECTA Ephemeroptera Ameletus

Ephemera

Plecoptera

Isogenus Taeniopteryx Hemiotera Corixidae

Megaloptera Trichoptera

Glossosoma Helicopsyche Hydropsyche Hydroptila Lepidostoma

Coleoptera Dryopidae Elmidae Diptera Tipulidae Chironomidae Ephydridae

#### RIPARIAN VEGETATION

Bank coverage (%) Coniferous trees 45 45 Deciduous trees Shrubs 80 Grasses Barren Channel cover (%) Overhang Crown

#### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

#### STREAM GAUGING DATA

Water Survey of Canada station number 07DB003

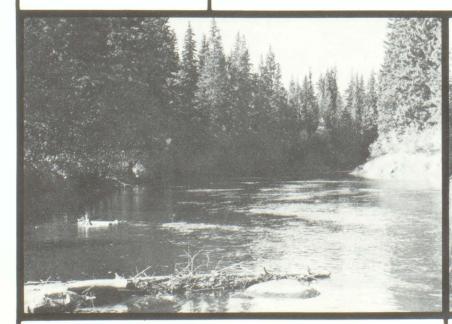
Maximum total annual discharge:  $182.6 \times 10^6 \text{ m}^3$  (1978) Minimum total annual discharge: 5.78 m<sup>3</sup>/s (1978) Maximum annual mean discharge: Minimum annual mean discharge: 2.25 m<sup>3</sup>/s (1977) Maximum monthly mean discharge: 23.11 m<sup>3</sup>/s (September 1978 0.03 m<sup>3</sup>/s (January 1976) 33.70 m<sup>3</sup>/s (Sept. 18, 1978) Minimum monthly mean discharge: Maximum daily discharge:

Data for 1975 to 1978 compiled from Loeppky and Spitzer (1977) Warner and Spitzer (1979) and Warner (1979).

0.02 m<sup>3</sup>/s (Feb. 28, 1978) Minimum daily discharge:

> Data for the period January 1976 to December 1979 obtained from the National Water Quality Data Bank (NAQUADAT).

Water Survey of Canada station number 00AT07DB0030



Swirling pool conditions at km 26.5.



Dunkirk River at km 40.8.

## AQUATIC BIOPHYSICAL INVENTORY DUNKIRK RIVER

Reach 2 (km 16.0 to km 56.2)





Maximum Minimum

39.5

47.2

< 0.4

17.0

0.58

0.046

0.008

83

6.65

273.0

267.1

595

348

44.0

14.5

159.0

2.41

0.500

0.180

0.130 0.470

8.50

Mean

7.60

156.0

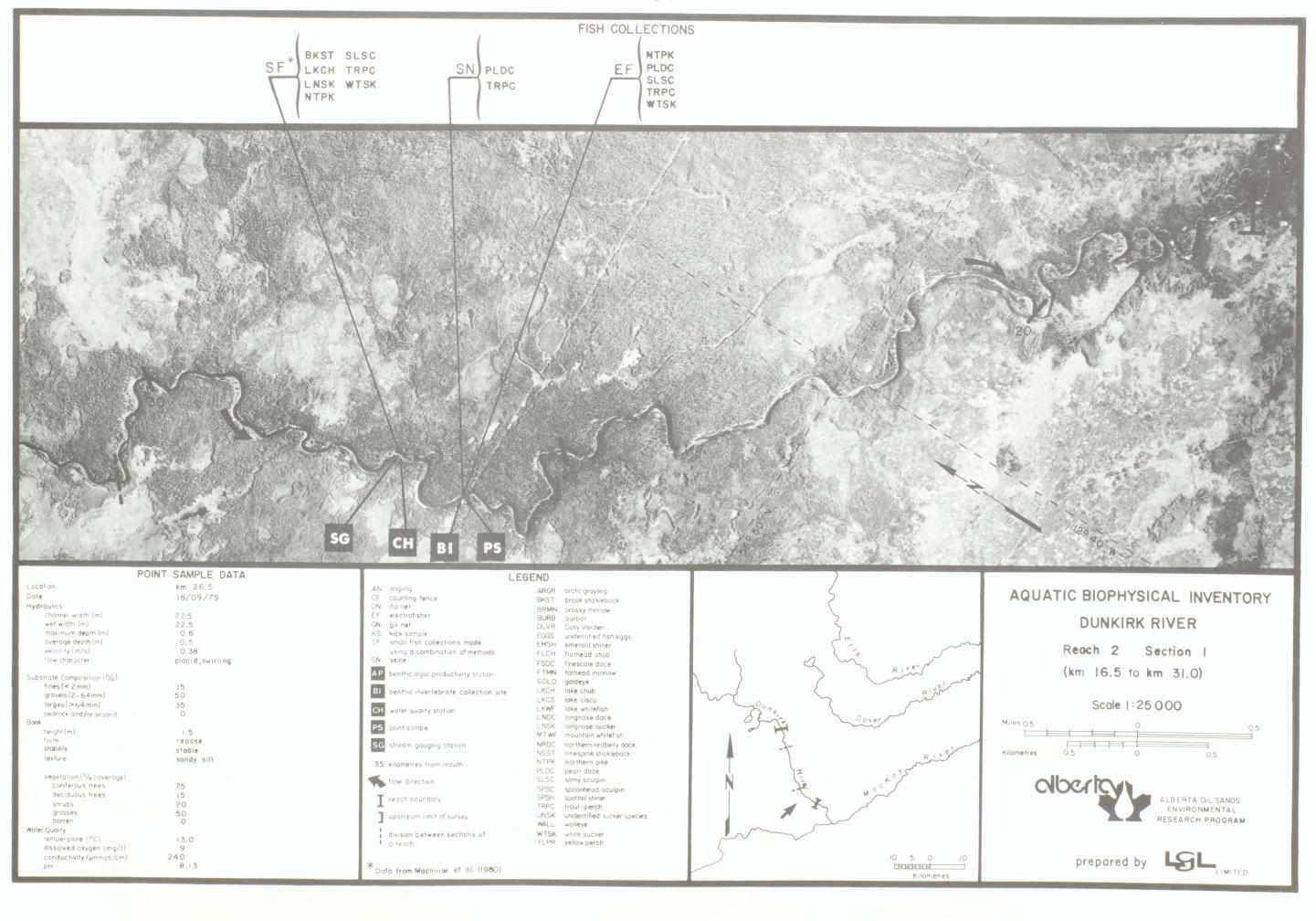
29.0

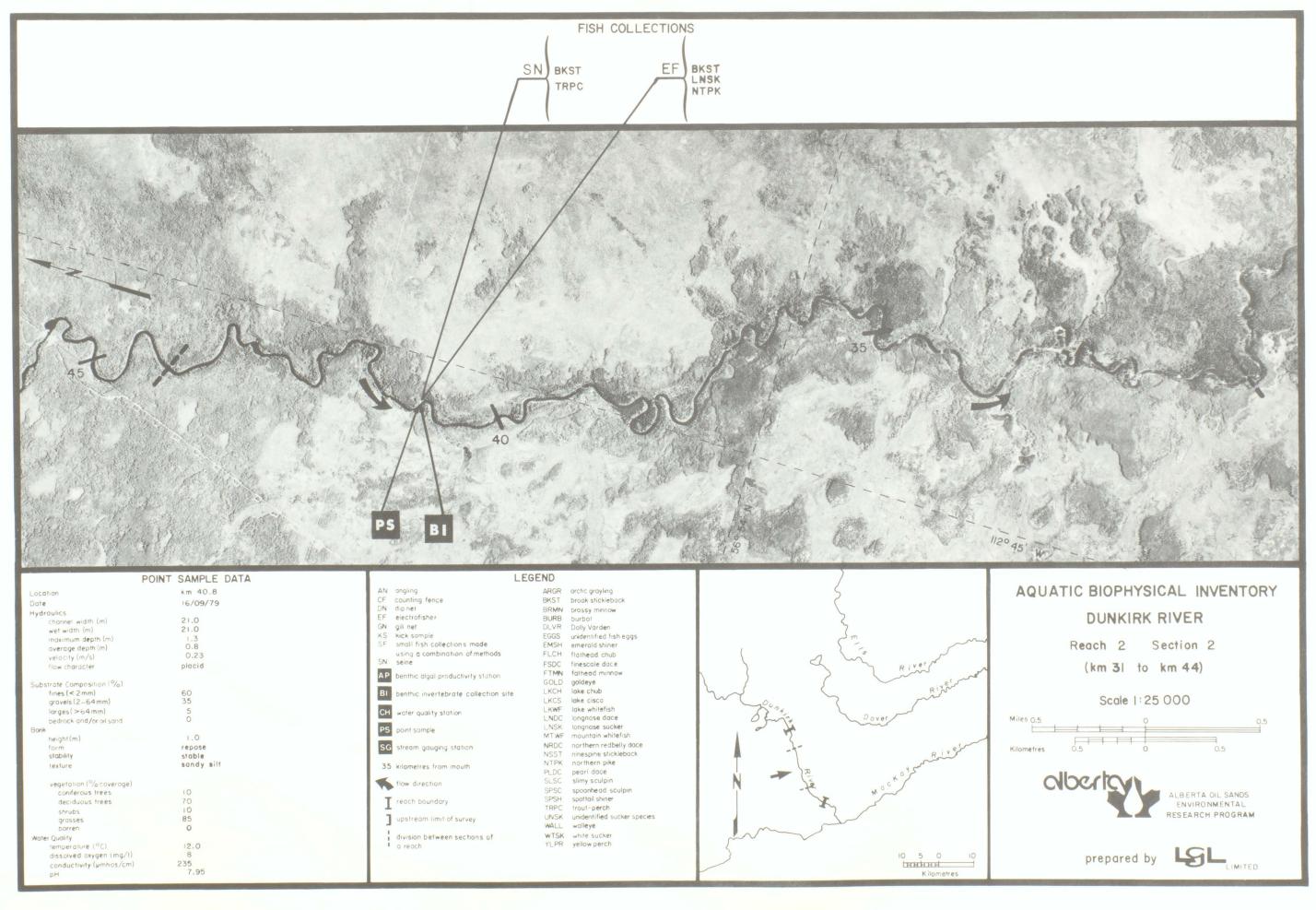
1.37

0.130

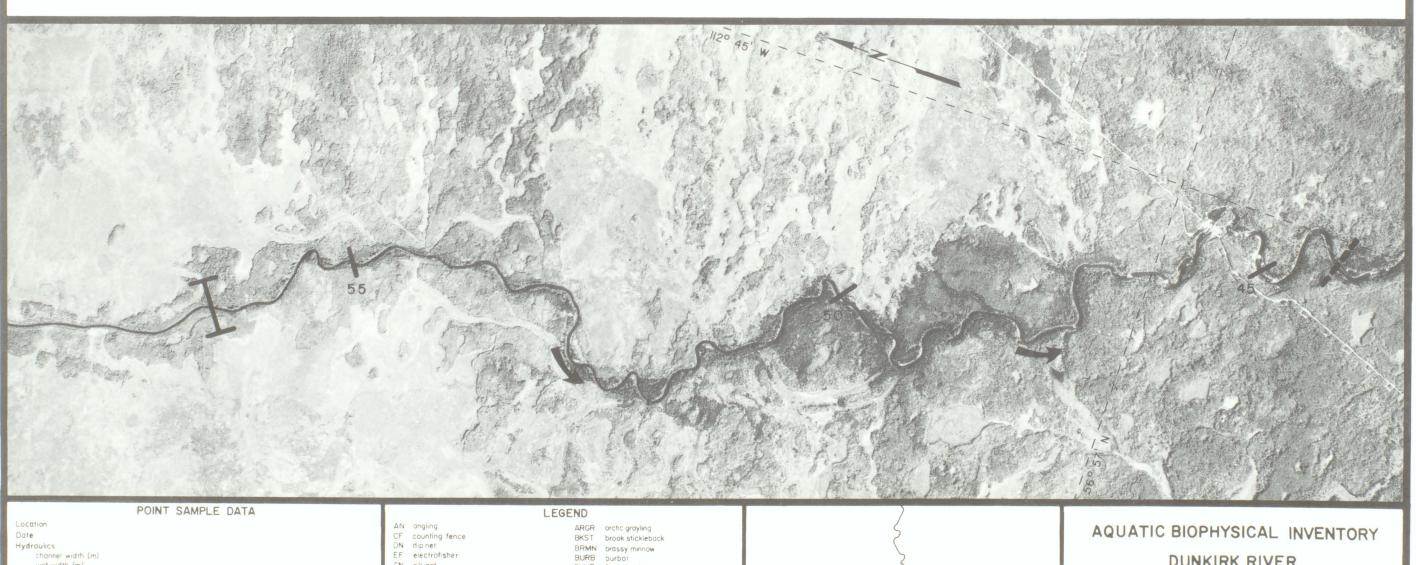
313

144.0





#### FISH COLLECTIONS



#### channel width (m) wet width (m) maximum depth (m) average depth (m) flow character Substrate Composition (%) gravels (2-64mm) larges (>64 mm) bedrock and/or oil sand height(m) stability texture vegetation (% coverage) conferous trees deciduous trees shrubs grasses barren Water Quality temperature (°C)

dissolved oxygen (mg/l) conductivity (µmhos/cm)

#### BRMN brassy minnow BURB burbot DLVR Dolly Varden EGGS unidentified fish eggs GN gill net KS kick sample SF small fish collections made EMSH emerald shiner FLCH flathead chub using a combination of methods FSDC finescale dace AP benthic algal productivity station FTMN fathead minnow GOLD goldeye BI benthic invertebrate collection site LKCH lake chub LKCS lake cisco CH water quality station

PS point sample

flow direction

T reach boundary

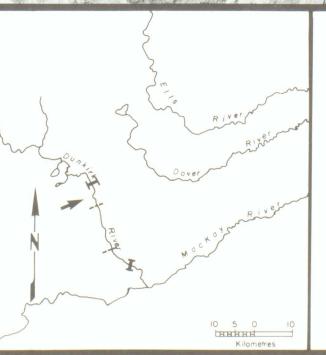
SG stream gauging station

35 kilometres from mouth

upstream limit of survey

division between sections of







Reach 2 Section 3 (km 44.0 to km 56.2)







Species	Adults	Juveniles and Young-of-the-year	Total Numbers
arctic grayling	I	0	1
brook stickleback	2	0	2
northern pike	0	2	2
pearl dace	0	7	7
Total	3	9	12

#### PHYSICAL CHARACTERISTICS

Reach length (km)	27.8
Channel width (m)	13
Channel area (ha)	36.1
Gradient (m/km)	0.2
Flow character	placid
Total pools (%)	100
Pattern	irregularly meandering
Confinement	unconfined
Unstable banks (%)	2
Substrate composition (%)	
fines (<2 mm)	100
gravels (2-64 mm)	0
larges (>64 mm)	0
bedrock and/or oil sand	0
Debris	moderate

#### REACH DESCRIPTION AND FISH UTILIZATION

This uppermost reach of the surveyed portion of the Dunkirk River meanders in an irregular pattern through a marshy muskeg region. The gradient is very low, the stream channel is deep, and the water flow is slow. The substrate is entirely silt with a high organic detritus content. Aquatic vegetation is abundant. The riparian vegetation consists primarily of deciduous trees and shrubs, but patches of coniferous trees are also fairly numerous. Fairly large amounts of shrubs and grasses overhang the river channel throughout the reach. Moderate amounts of debris are present in the channel.

The abundant aquatic vegetation in this reach provides many areas suitable for spawning of northern pike and brook stickleback. The reach does not appear to be suitable for spawning of other fish species. Rearing potential is good because of the low water velocities, the shade provided by overhanging vegetation, and the ample shelter provided by woody debris and aquatic vegetation. Water depths in this reach appear to be sufficient to allow overwintering of fish.

#### BENTHIC INVERTEBRATES

HIRUDINEA Glossiphoniidae GASTROPODA

PELECYPODA

CRUSTACEA Cladocera Amphipoda

Gammarus pseudolimna

INSECTA

Ephemeroptera

Odonata

Hemiptera Corixidae Megaloptera

Trichoptera

Polycentropus Ptilostomis

Coleoptera Dryopidae Elmidae

Diptera Ceratopogonidae Chironomidae Chironominae Tanypodinae

## RIPARIAN VEGETATION

Crown

Bank coverage (%) Coniferous trees Deciduous trees 40 Shrubs Grasses Barren Channel cover (%) Overhang

#### BENTHIC ALGAL PRODUCTIVITY

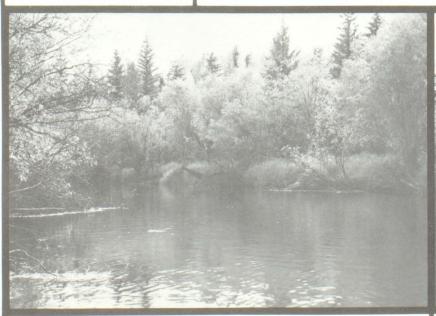
No data available for this reach

#### STREAM GAUGING DATA

No data available for this reach

#### WATER QUALITY

No data available for this reach



A representative section of reach 3 at km 58.5.

Overhanging bank vegetation and abundant aquatic vegetation at km 82.2.

## AQUATIC BIOPHYSICAL INVENTORY DUNKIRK RIVER

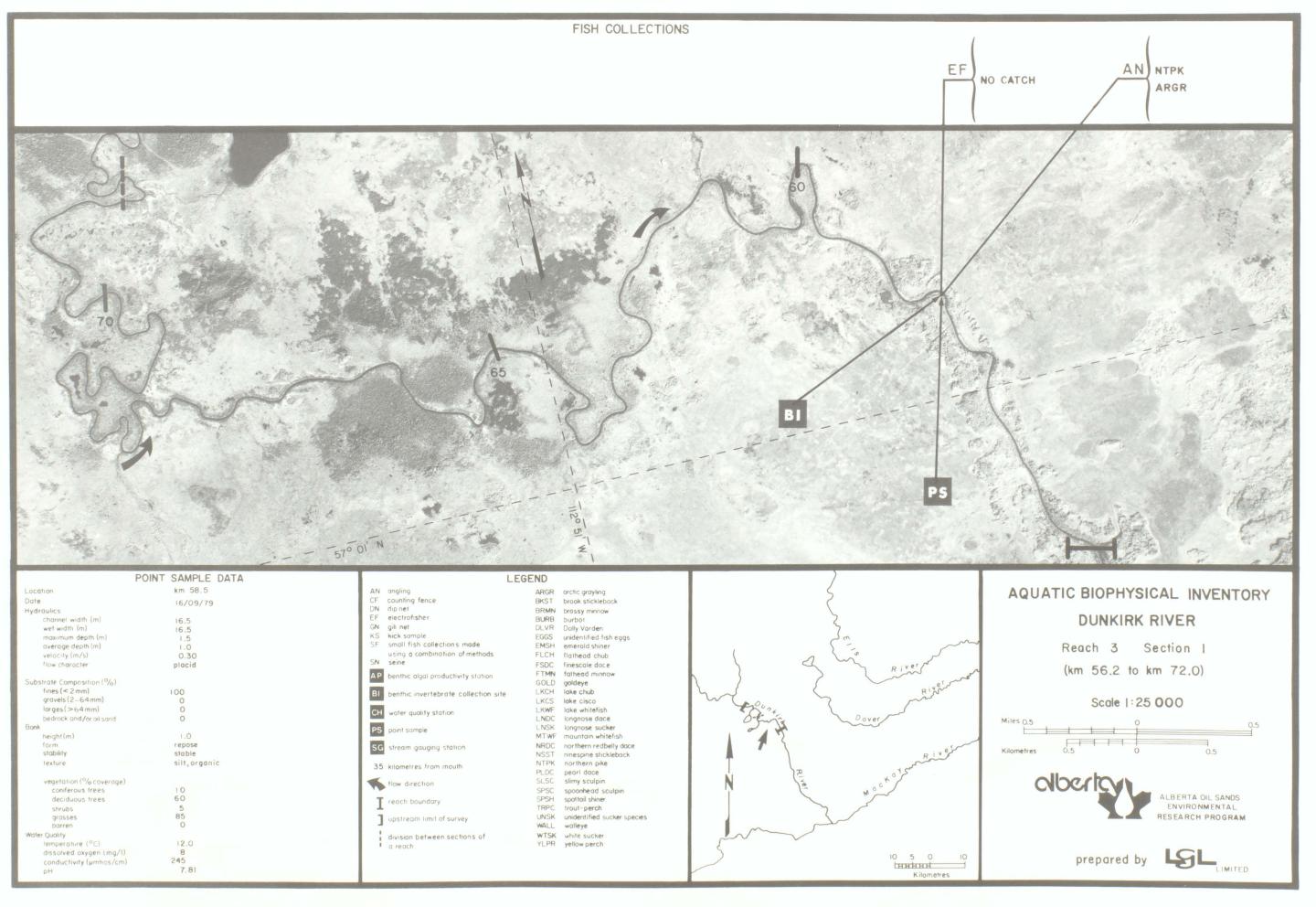
Reach 3 (km 56.2 to km 84.0)

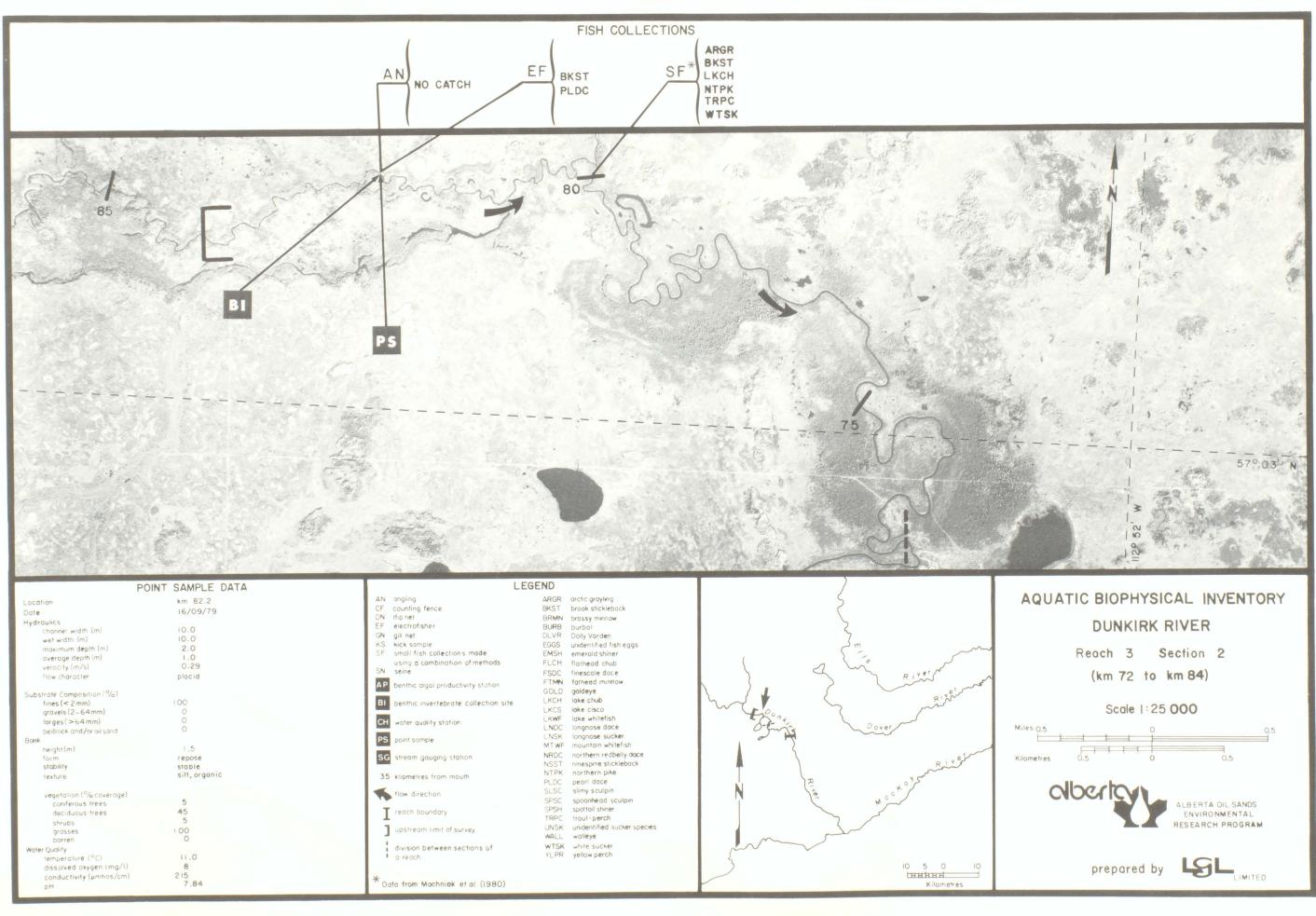


ALBERTA OIL SANDS ENVIRONMENTAL RESEARCH PROGRAM

prepared by LSL LIMITED

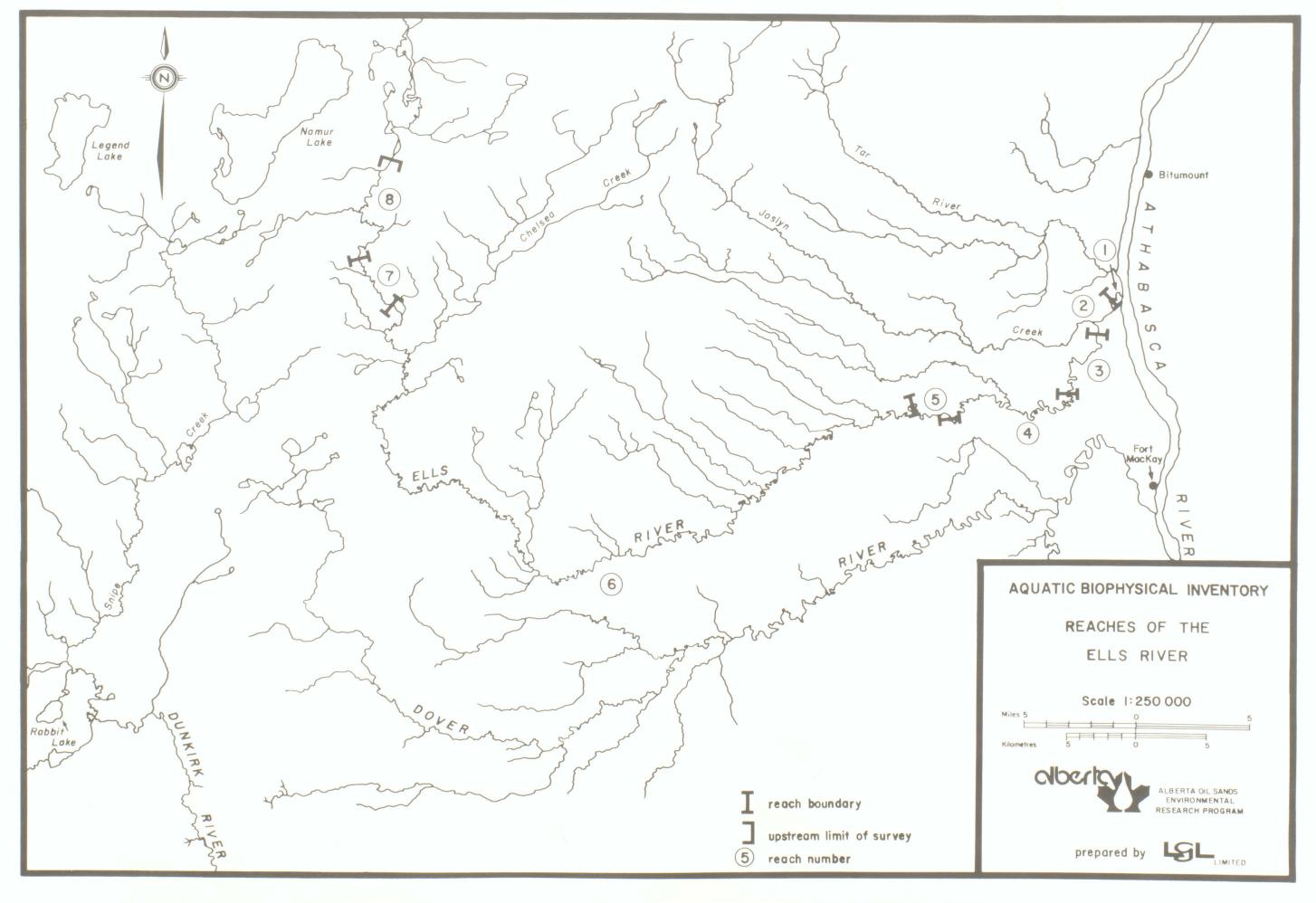






		5

# ELLS RIVER



	А	Adults		niles and of-the-year	Total Numbers	
Species	June	September	June	September	June	Septembe
burbot	ND	1	ND	0	ND	1
flathead chub	ND	1	ND	1	ND	2
goldeye	ND	7	ND	6	ND	13
lake whitefish	ND	6	ND	0	ND	6
longnose sucker	ND	3	ND	1	ND	4
mountain whitefish	ND	1	ND	0	ND	1
northern pike	ND	0	ND	1	ND	1
walleye	ND	3	ND	2	ND	5
Total	ND	22	ND	11	ND	33

#### PHYSICAL CHARACTERISTICS

Reach length (km)	2.5
Channel width (m)	35
Channel area (ha)	8.8
Gradient (m/km)	1.7
Flow character	placid, swirling
Total pools (%)	100
Pattern	tortuously meandering
Confinement	occasionally confined
Unstable banks (%)	20
Substrate composition (%)	
fines (<2 mm)	100
gravels (2-64 mm)	0
larges (>64 mm)	0
bedrock and/or oil sand	0
Debris	1 ow

#### REACH DESCRIPTION AND FISH UTILIZATION

Much of this short, tortuously meandering section of the Ells River lies within the Athabasca River floodplain. The gradient is fairly low and the entire reach is a pool with either placid or swirling flow. In most areas of the reach, the water is relatively deep. The substrate material is entirely fines. The riparian vegetation is dominated by deciduous trees and shrubs, but some conifers are present. There is also a fairly dense growth of grasses. None of the bank vegetation overhangs the channel.

Spawning potential for those fish species that usually spawn over sandy substrates is considered to be excellent. No suitable spawning areas exist for species that require gravel substrates. Very few areas within this reach are suitable for fish rearing. The slow water velocities may permit young fish to inhabit waters within the reach, but there are only a limited number of areas that provide suitable shelter. Resting and feeding potential for larger fish is considered to be moderate to good because the reach is essentially a deep continuous pool. However, there are few areas that provide any shelter. Because of the generally deep water and extensive pools, the overwintering potential of this reach is considered to be excellent.

#### BENTHIC INVERTEBRATES

No benthic samples were taken in this reach.

RIPARIAN VEGETATION	
Bank coverage (%)	_
Coniferous trees	5
Deciduous trees	45
Shrubs	35
Grasses	75
Barren	0
Channel cover (%)	
Overhang	0
Crown	0

#### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

#### STREAM GAUGING DATA

No data available for this reach

#### WATER QUALITY

Water Survey of Canada station number 00AT07DA0098

	Mean	Maximum	Minimum
Total alkalinity (mg CaCO <sub>3</sub> /1) pH	79.9 7.70	105.1	62.9 7.30
Total hardness (mg CaCO <sub>3</sub> /1)	75.0	88.0	65.0
Conductance (µS/cm)	178	250	115
Total filterable			
residue fixed (mg/1)	80	114	50
Total non-filterable			
residue fixed (mg/1)	11	38	< 0.4
Total organic carbon (mg C/1)	19.0	40.5	12.0
Silica (mg SiO <sub>2</sub> /1)	3.2	9.0	< 0.2
Nitrate and nitrite nitrogen (mg N/1)	0.090	0.280	< 0.003
Total Kjeldahl nitrogen (mg N/1)	0.99	1.78	0.64
Total Phosphorus (mg P/1)	0.051	0.170	0.016
Orthophosphate (mg P/1)	0.013	0.034	0.005
Sulphate (mg SO <sub>4</sub> /1)	17.0	23.8	7.4

Data for the period January 1976 to December 1979 obtained from the National Water Quality Data Bank (NAQUADAT).

# AQUATIC BIOPHYSICAL INVENTORY ELLS RIVER

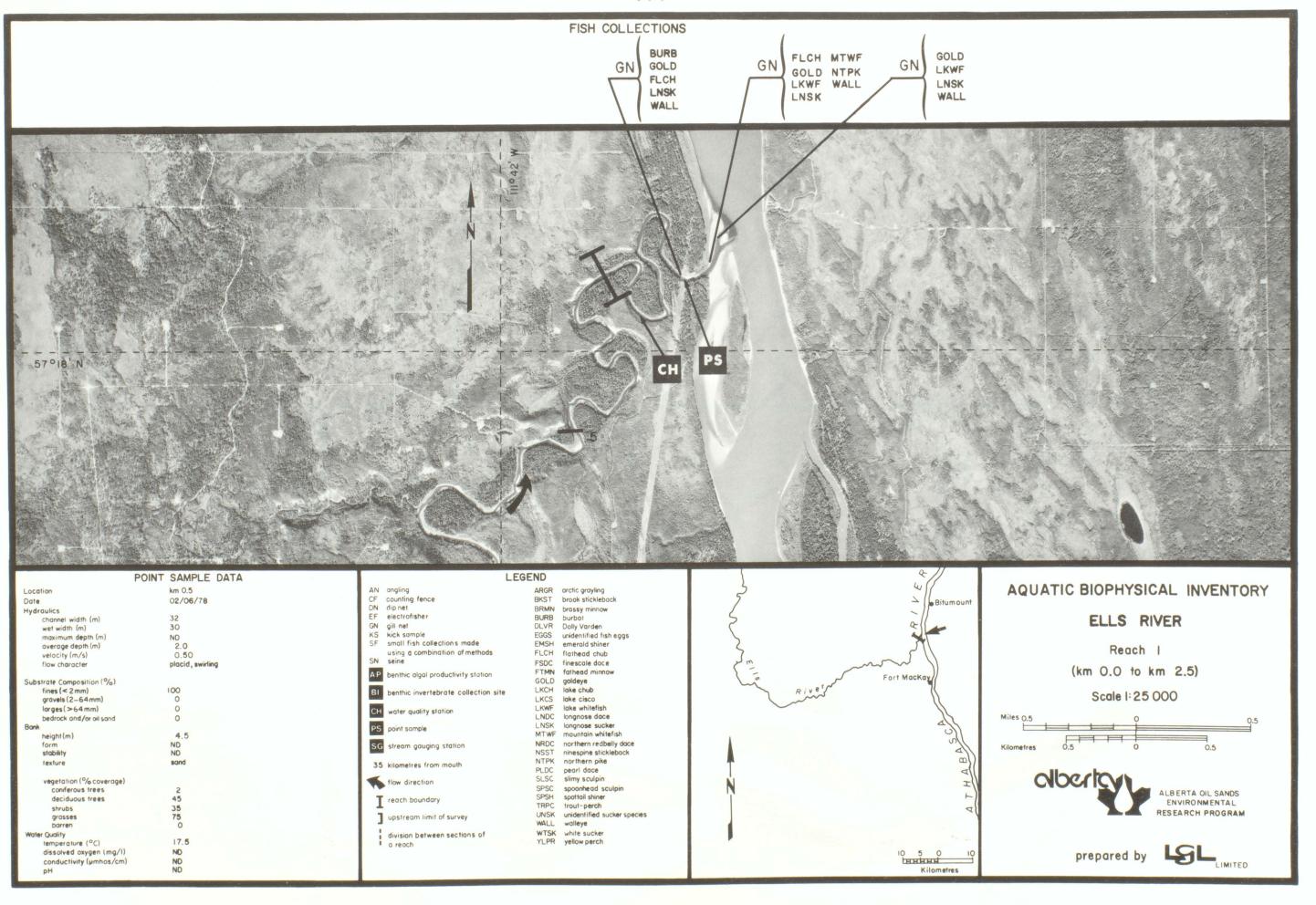
Reach | (km 0.0 to km 2.5)







Wide, placid section of the Ells River at km 1.



Species	Adults		Juveniles and Young-of-the-year		Total Numbers	
	June	September	June	September	June	September
brook stickleback	0	0	1	2	1	2
lake chub	0	21	9	119	9	140
longnose dace	0	0	8	13	8	13
longnose sucker	0	0	3	21	3	21
mountain whitefish	0	0	0	1	0	1
northern pike	0	0	1	0	1	0
slimy sculpin	0	0	0	17	0	17
trout-perch	0	0	0	18	0	18
unidentified suckers	0	0	0	2	0	2
walleye	0	0	2	0	2	0
white sucker	0	0	4	12	14	12
Total	0	21	28	205	28	226

#### PHYSICAL CHARACTERISTICS

Reach length (km)	5.5
Channel width (m)	35
Channel area (ha)	19.3
Gradient (m/km)	1.6
Flow character	placid, swirling
Total pools (%)	100
Pattern	irregularly meandering
Confinement	confined
Unstable banks (%)	40
Substrate composition (%)	
fines (<2 mm)	90
gravels (2-64 mm)	10
larges (>64 mm)	0
bedrock and/or oil sand	0
Debris	moderate

#### REACH DESCRIPTION AND FISH UTILIZATION

This relatively short, irregularly meandering reach lies above the Athabasca River floodplain. The gradient is relatively low and this entire section of the river consists of deep pools with placid and swirling flow. The substrate is composed primarily of fines, but a few areas contain gravels. Deciduous trees and shrubs are the dominant components of the riparian vegetation, but some patches of conifers are also present. Little vegetation overhangs the channel.

Most areas within the reach provide suitable spawning grounds for those fish that normally spawn over sandy substrates. Only a few areas are suitable for spawning by those fish that prefer gravel substrates. Rearing potential in this reach is considered to be moderate; slow water velocities and moderate quantities of debris provide suitable rearing areas. Moderate numbers of young-of-the-year and juvenile fish, particularly lake chub, were captured in this section of the river during the study. Resting and feeding potential for larger fish is considered to be good to excellent because of the many deep pools and areas sheltered by debris. There is a variety of smaller fishes in this reach that may serve as prey for piscivorous species such as walleye and northern pike. Overwintering potential is considered to be excellent because of the deep pools.

#### BENTHIC INVERTEBRATES

No benthic samples were taken in this reach.

#### RIPARIAN VEGETATION

Overhang

Bank coverage (%)
Coniferous trees 10
Deciduous trees 50
Shrubs 25
Grasses 15
Barren 0
Channel cover (%)

#### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

#### STREAM GAUGING DATA

No data available for this reach

#### WATER QUALITY

No data available for this reach



Undercut banks at km 4.

# AQUATIC BIOPHYSICAL INVENTORY ELLS RIVER

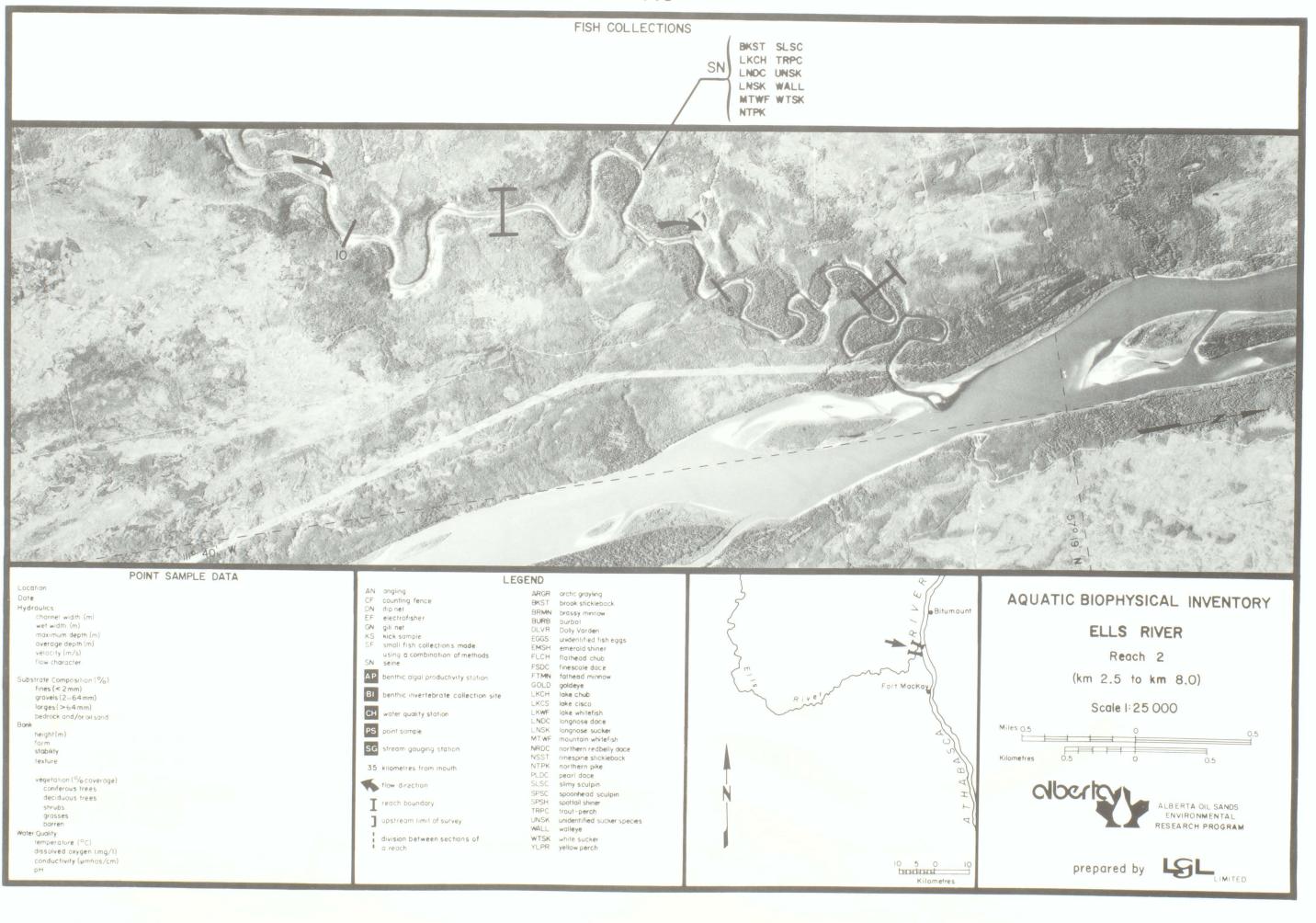
Reach 2 (km 2.5 to km 8.0)



ENVIRONMENTAL
RESEARCH PROGRAM

prepared by





	Adults			Juveniles and Young-of-the-year		Total Numbers	
Species	June	September	June	September	June	September	
goldeye	0	0	3	0	3	0	
lake chub	14	6	22	119	26	125	
longnose dace	0	0	2	10	2	10	
longnose sucker	0	1	0	3	0	4	
trout-perch	0	2	0	4	0	6	
white sucker	0	0	0	2	0	2	
Total	4	9	27	138	31	147	

#### PHYSICAL CHARACTERISTICS

Reach length (km)	10.0
Channel width (m)	30
Channel area (ha)	30.0
Gradient (m/km)	3.8
Flow character	swirling, rolling, broker
Total pools (%)	75
Pattern	irregularly meandering
Confinement	entrenched
Unstable banks (%)	35
Substrate composition (%)	
fines (<2 mm)	25
gravels (2-64 mm)	25
larges (>64 mm)	40
bedrock and/or oil sand	10
Debris	low

#### REACH DESCRIPTION AND FISH UTILIZATION

This section of the Ells River is entrenched within a narrow deep canyon and meanders in an irregular pattern. Although the gradient is high and riffle sections are numerous, a relatively high proportion of the reach is composed of pools. The flow character is mixed, varying from swirling to rolling to broken, and water depths are generally shallow. Substrate composition is varied; larges predominate, but gravels and fines also compose substantial proportions of the substrate. The riparian vegetation is a mixture of coniferous and deciduous trees; deciduous shrubs are also fairly abundant. A small amount of vegetation overhangs the channel.

Because of the diversity of substrate materials and water velocities and depths, spawning potential in this section of the river is considered to be excellent for most fish species that occur in the Ells River. Suitable areas for the rearing of fish include the rocky substrates, a few areas sheltered by overhanging vegetation, and the scattered grassy shallows. Moderate numbers of young fish, particularly lake chub, were captured in this reach during the study. The numerous pools and the few areas shaded by overhanging vegetation provide good resting and feeding potential for larger fish. Although a large proportion of the reach is composed of pools, only a few of these areas are deep enough to provide suitable overwintering areas for fish.

#### BENTHIC INVERTEBRATES OLIGOCHAETA INSECTA

Ephemeroptera

Odonata Ophiogomphus Plecoptera

HastaperlaColeoptera Elmidae

Diptera Tipulidae Chironomidae Chironominae Tanypodinae Orthocladiinae Simuliidae Rhagionidae

#### RIPARIAN VEGETATION

Crown

Bank coverage (%) 45 Coniferous trees Deciduous trees Shrubs 25 Grasses Barren Channel cover (%) Overhang

#### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

#### STREAM GAUGING DATA

Water Survey of Canada station number 07DA017

Maximum total annual discharge:  $324.4 \times 10^6 \text{ m}^3$  (1978) Minimum total annual discharge: 135.9 x 10<sup>6</sup> m<sup>3</sup> (1977) 10.31 m<sup>3</sup>/s (1978) Maximum annual mean discharge: Minimum annual mean discharge: Maximum monthly mean discharge: 27.78 m<sup>3</sup>/s (May 1978) Minimum monthly mean discharge: 0.64 m<sup>3</sup>/s (March 1977) Maximum daily discharge: 49.84 m³/s (Apr. 14, 1976) Minimum daily discharge: 0.46 m<sup>3</sup>/s (Mar. 26, 1977)

Data for 1975 to 1978 compiled from Loeppky and Spitzer (1977). Warner and Spitzer (1979) and Warner (1979).

#### WATER QUALITY

Water Survey of Canada station number 00AT07DA0170

	Mean	Maximum	Minimum
Total alkalinity (mg CaCO <sub>3</sub> /1) pH	93.4	150.4	53.6 7.20
Total hardness (mg CaCO <sub>3</sub> /1)	92.5	140.2	58.5
Conductance (µS/cm)	211	370	110
Total filterable			
residue fixed (mg/1)	110	179	57
Total non-filterable			
residue fixed (mg/l)	22	326	< 0.4
Total organic carbon (mg C/1)	15.0	41.5	7.5
Silica (mg SiO <sub>2</sub> /1)	4.0	9.9	0.4
Nitrate and nitrite nitrogen (mg N/1)	0.130	0.430	0.003
Total Kjeldahl nitrogen (mg N/1)	0.87	2.17	0.20
Total Phosphorus (mg P/1)	0.050	0.340	0.009
Orthophosphate (mg P/1)	0.010	0.060	< 0.003
Sulphate (mg SO <sub>4</sub> /1)	16.7	30.2	9.3

Data for the period January 1976 to December 1979 obtained from the National Water Quality Data Bank (NAQUADAT).



Ells River at km 14.



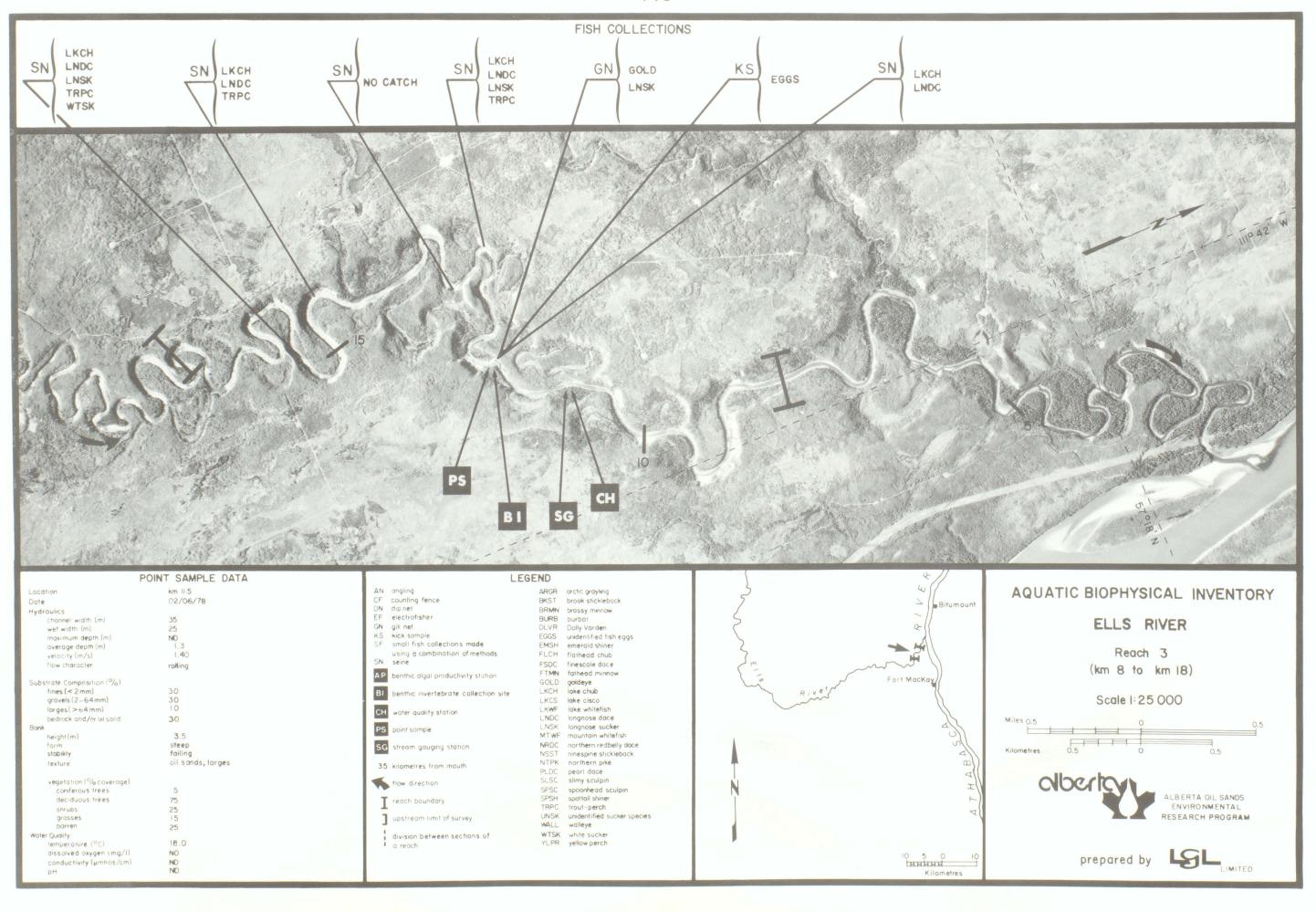
High, unstable bank at km 16.

# AQUATIC BIOPHYSICAL INVENTORY ELLS RIVER

Reach 3 (km 8 to km 18)







	А	Adults		Juveniles and Young-of-the-year		Total Numbers	
Species	June	September	June	September	June	September	
lake chub	0	15	288	428	288	443	
longnose dace	0	0	24	17	24	17	
longnose sucker	0	0	33	46	33	46	
northern pike	0	2	0	0	0	2	
pearl dace	0	T	4	59	4	60	
trout-perch	0	3	9	1	9	4	
unidentified suckers	0	0	0	6	0	6	
white sucker	0	1	80	43	80	44	
Total	0	22	438	600	438	622	

#### PHYSICAL CHARACTERISTICS

Reach length (km)	27.0
Channel width (m)	30
Channel area (ha)	81.0
Gradient (m/km)	0.9
Flow character	swirling, rolling
Total pools (%)	80
Pattern	tortuously meandering
Confinement	confined
Unstable banks (%)	40
Substrate composition (%)	
fines (<2 mm)	15
gravels (2-64 mm)	30
larges (>64 mm)	50
bedrock and/or oil sand	5
Debris	low

#### REACH DESCRIPTION AND FISH UTILIZATION

This reach is a tortuously meandering section of the Ells River, with a relatively low gradient and swirling and rolling flow. Most of the reach is composed of pools and the water is moderately deep. The substrate consists primarily of larges and gravels, but sand and silt substrates are present in some areas. Riparian vegetation is mostly deciduous trees, but scattered coniferous trees are present. There is a relatively small amount of overhanging vegetation.

Spawning potential in this section of the river is considered to be excellent for those fish that normally spawn over rocky substrates, and moderate for those that normally spawn over sandy substrates. Numerous backwater pools, weedy sheltered areas alongside the river bank, areas shaded by overhanging riparian vegetation, and rocky substrates provide excellent rearing opportunities for most fish species found in the Ells River. Very high numbers of young fish, particularly lake chub, were captured in this section of the river during the survey. Resting and feeding potential for larger fish is considered to be excellent because of the many pools and the areas along the banks that are sheltered by overhanging vegetation. There appears to be an abundant food supply for piscivorous fish. Particularly large numbers of smaller fish were collected in this reach. Overwintering potential is rated as moderate to good; the many pools provide suitable areas for larger fish.

#### BENTHIC INVERTEBRATES

Diptera Chironomidae Chironominae Tanypodinae Simuliidae

OLIGOCHAETA INSECTA Ephemeroptera Baetis Ephemerella Stenonema Odonata Ophiogomphus Plecoptera Isoperla Leuctra Trichoptera Hydropsyche Coleoptera Elmidae

#### RIPARIAN VEGETATION

Bank coverage (%) Coniferous trees Deciduous trees Shrubs Grasses Barren Channel cover (%) Overhang Crown

#### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

#### STREAM GAUGING DATA

No data available for this reach

#### WATER QUALITY

No data available for this reach



Long section of eroded bank at km 22.

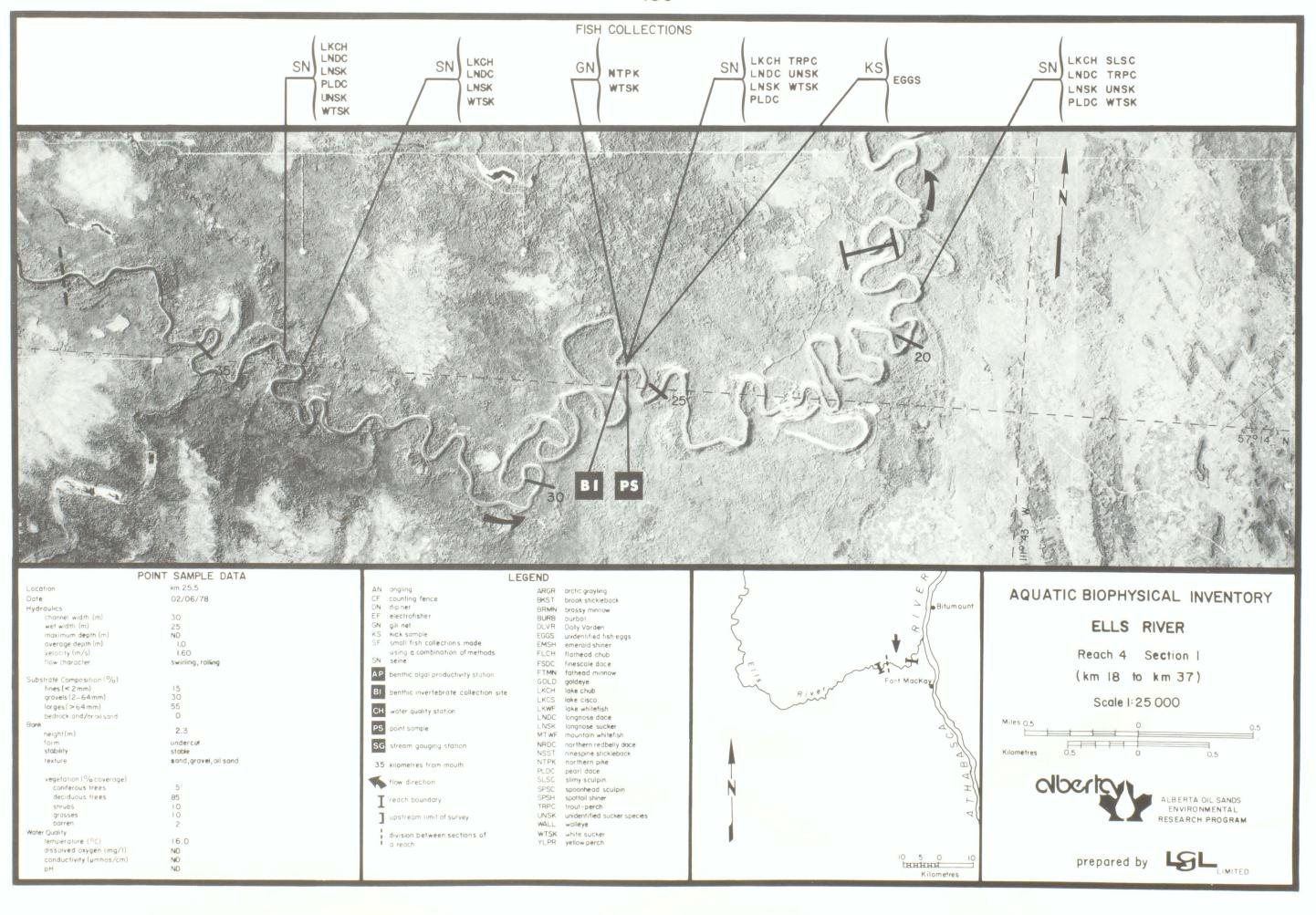
Swirling and rolling flow character at km 26 is typical of reach 4.

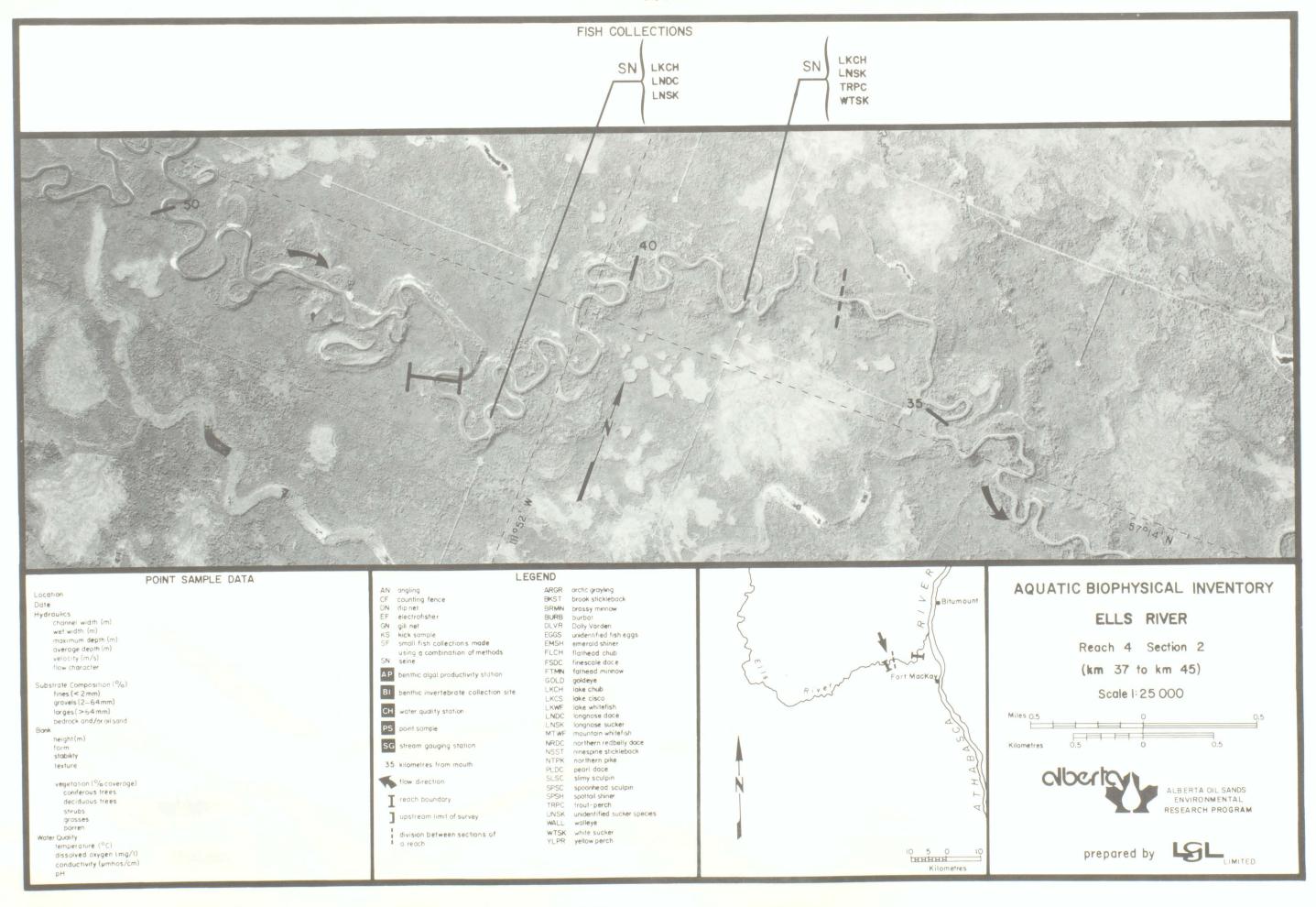
# AQUATIC BIOPHYSICAL INVENTORY ELLS RIVER

Reach 4 (km 18 to km 45)









#### NUMBERS OF FISH CAPTURED (1978)

	А	Adults		Juveniles and Young-of-the-year		Total Numbers	
Species	June	September	June	September	June	September	
arctic grayling	ND	0	ND	1	ND	1	
lake chub	ND	10	ND	56	ND	66	
longnose dace	ND	0	ND	17	ND	17	
longnose sucker	ND	1	ND	11	ND	12	
northern pike-	ND	1	ND	0	ND	1	
pearl dace	ND	0	ND	4	ND	4	
trout-perch	ND	28	ND	1	ND	29	
unidentified suckers	ND	0	ND	1	ND	1	
Total	ND	40	ND	91	ND	131	

#### PHYSICAL CHARACTERISTICS

Reach length (km)	6.0
Channel width (m)	25
Channel area (ha)	15.0
Gradient (m/km)	4.1
Flow character	rolling, broken
Total pools (%)	25
Pattern	irregularly meandering
Confinement	confined
Unstable banks (%)	20
Substrate composition (%)	
fines (<2 mm)	20
gravels (2-64 mm)	30
larges (>64 mm)	45
bedrock and/or oil sand	5
Debris	moderate

#### REACH DESCRIPTION AND FISH UTILIZATION

This section is a short, irregularly meandering reach that is essentially a series of riffles. Although gradient and water velocities are relatively high, there is a moderate number of pools. Water depths are fairly shallow over most of the reach. Substrates are predominantly larges and gravels, but there are also numerous areas with sandy substrates. Deciduous trees and shrubs comprise the major part of the riparian vegetation, and there is a small amount of vegetation that overhangs the channel. There is a moderate amount of debris in this reach.

The diversity of substrate sizes, current velocities and water depths provides excellent spawning potential for most fish species that occur in the Ells River, particularly for those fish that prefer to spawn over rocky substrates. Rearing potential is considered to be good because the moderate quantities of debris and the rocky substrates provide suitable shelter. Some areas along the banks that are shaded by overhanging vegetation are also suitable rearing areas. Suitable resting and feeding areas for larger fish are found in some of the areas sheltered by overhanging vegetation and debris. However, only a few backwater pools and eddies in the reach provide sufficiently deep waters for larger fish; resting and feeding potential for these fish is therefore considered to be poor. Shallow water depths and the paucity of deep pools preclude significant overwintering of fish in this reach.

#### BENTHIC INVERTEBRATES

No benthic samples were taken in this reach.

#### RIPARIAN VEGETATION

Bank coverage (%) Coniferous trees 10 Deciduous trees Shrubs Grasses Barren Channel cover (%) Overhang Crown

#### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

#### STREAM GAUGING DATA

No data available for this reach

#### WATER QUALITY

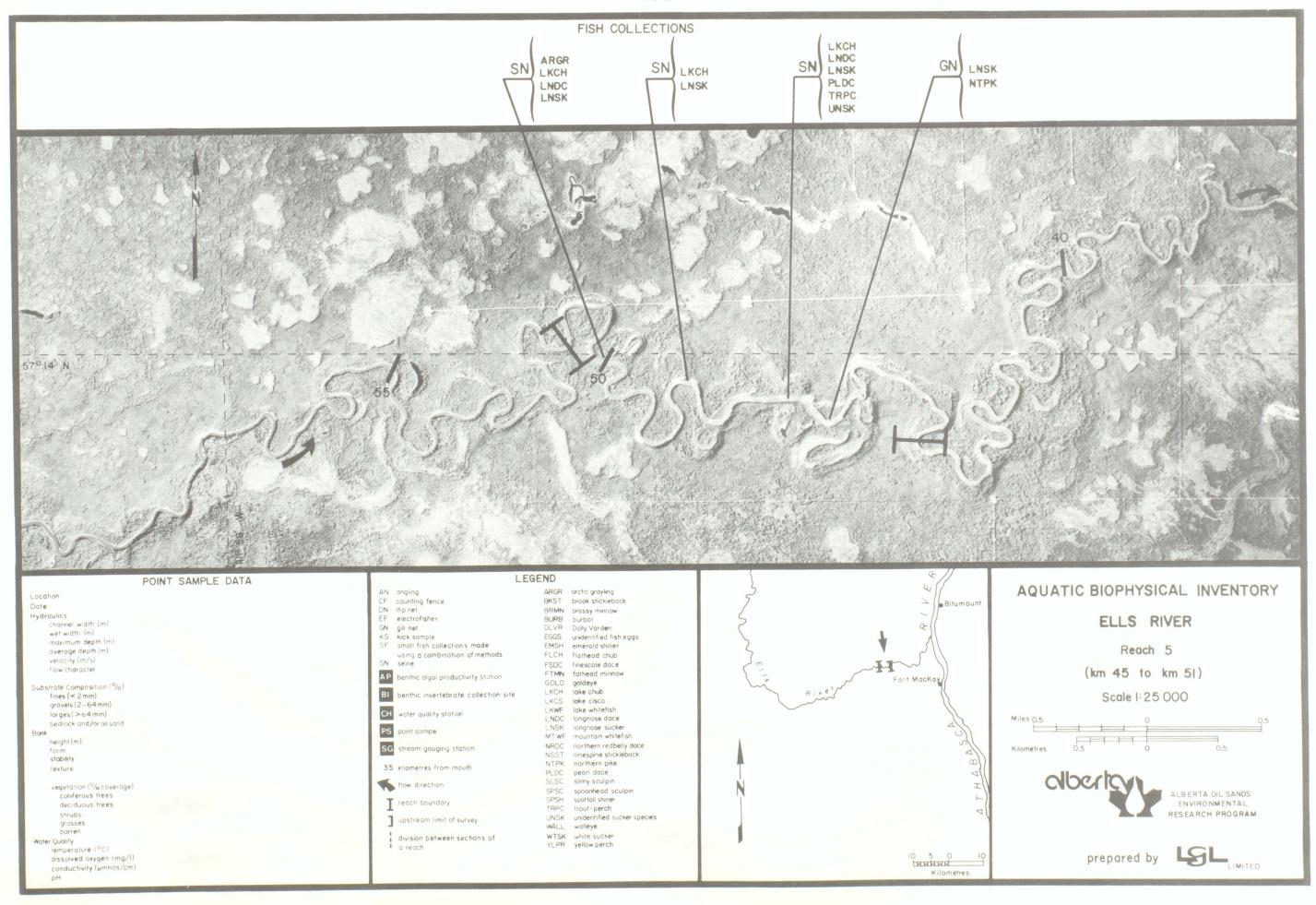
No data available for this reach

# AQUATIC BIOPHYSICAL INVENTORY ELLS RIVER

Reach 5 (km 45 to km 51)







	Adults		Juveniles and Young-of-the-year		Total Numbers	
Species	May/June	September	May/June	September	May/June	September
arctic grayling	0	0	29	4	29	4
lake chub	0	48	238	298	238	346
longnose dace	1	1	97	38	98	39
longnose sucker	1	0	32	11	33	11
northern pike	0	5	0	0	0	5
pearl dace	0	0	2	48	2	48
slimy sculpin	39	3	2	3	41	6
spoonhead sculpin	0	0	Ţ	0	Ĩ	0
trout-perch	19	61	35	27	54	88
unidentified suckers	0	0	0	1.1	0	11
walleye	2	2	0	0	2	2
white sucker	3	9	42	37	45	46
Total	65	129	478	477	543	606

RIPARIAN VEGETATION

Grasses Barren

Bank coverage (%)

Channel cover (%) Overhang

Coniferous trees Deciduous trees

#### PHYSICAL CHARACTERISTICS

Reach length (km)	123.0
Channel width (m)	30
Channel area (ha)	369.0
Gradient (m/km)	1.9
Flow character	swirling, rolling, broke
Total pools (%)	60
Pattern	tortuously meandering
Confinement	frequently confined
Unstable banks (%)	35
Substrate composition (%)	
fines (<2 mm)	30
gravels (2-64 mm)	30
larges (>64 mm)	40
bedrock and/or oil sand	0
Debris	moderate

#### REACH DESCRIPTION AND FISH UTILIZATION

This section is a long, tortuously meandering reach with a moderate gradient. It is a series of alternating pools and riffles, and just over half of the reach area is composed of pools. Water depths are relatively shallow over most of the reach. Substrates are varied, depending on location in the reach, and consist of larges, gravels and fines. The riparian vegetation is dominated by deciduous trees and shrubs, but grasses and significant numbers of conifers are also present. There is somewhat more overhanging vegetation in this section than in other reaches in the surveyed portion of the river.

Because of the variety of habitats provided by the long series of pools and riffles, the spawning potential of this reach is considered to be excellent for fish that normally spawn over rocky or sandy substrates. Adults of several species that spawn in the spring were captured here in May and June during this study. Areas sheltered by overhanging bank vegetation and debris and areas with rocky substrates provide excellent rearing habitat for many fish species. Very high numbers of young fish, particularly lake chub, were captured in the reach during this study. Overhanging vegetation, moderate quantities of debris, and numerous pools provide good resting and feeding areas for larger fish, particularly the piscivorous species. Overwintering potential for fish is considered to be moderate; many of the pools are probably too shallow to provide suitable overwintering areas.

#### BENTHIC INVERTEBRATES

GASTROPODA

Plecoptera

Trichoptera

Empididae

Chironomidae Chironominae Tanypodinae Orthocladiinae

A riffle section and high, unstable bank at km 107.

#### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

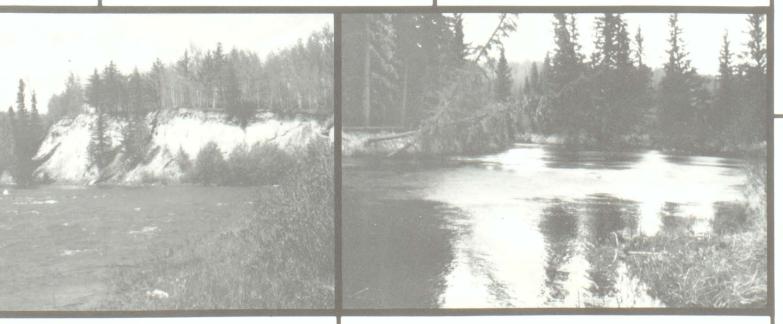
#### STREAM GAUGING DATA

No data available for this reach

An area of slower, swirling flow and heavily grassed banks at km 141.

#### WATER QUALITY

No data available for this reach

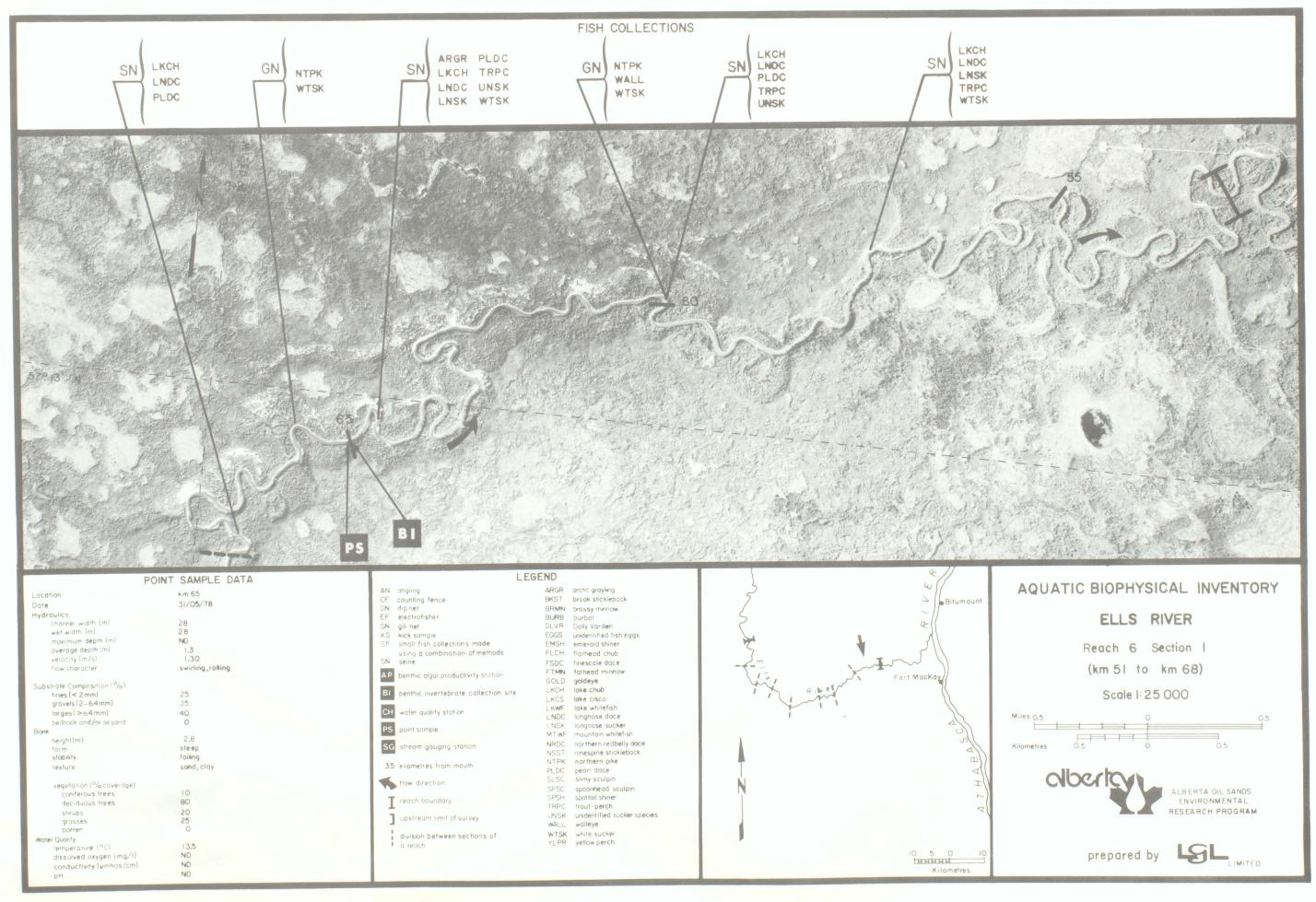


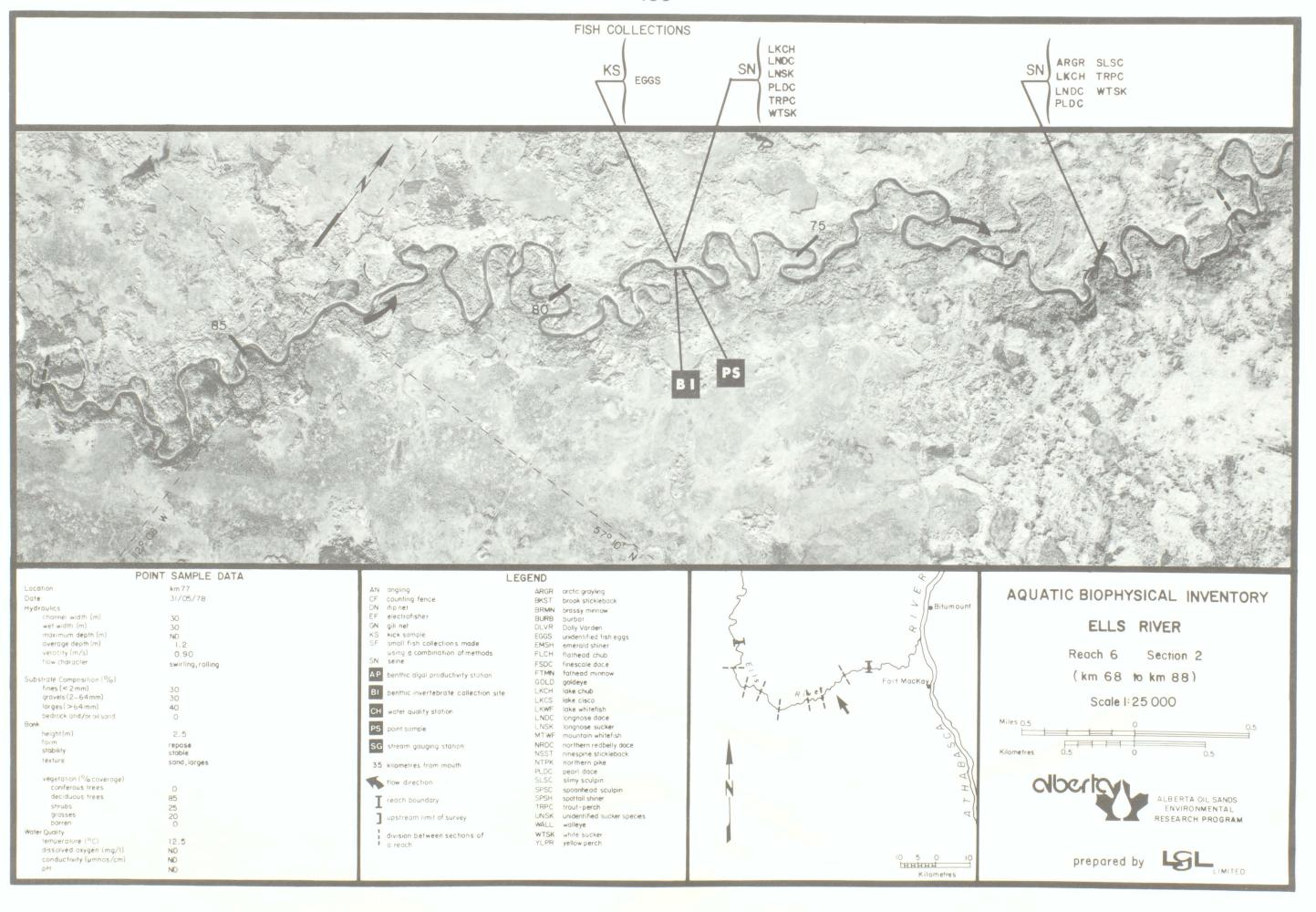
AQUATIC BIOPHYSICAL INVENTORY ELLS RIVER

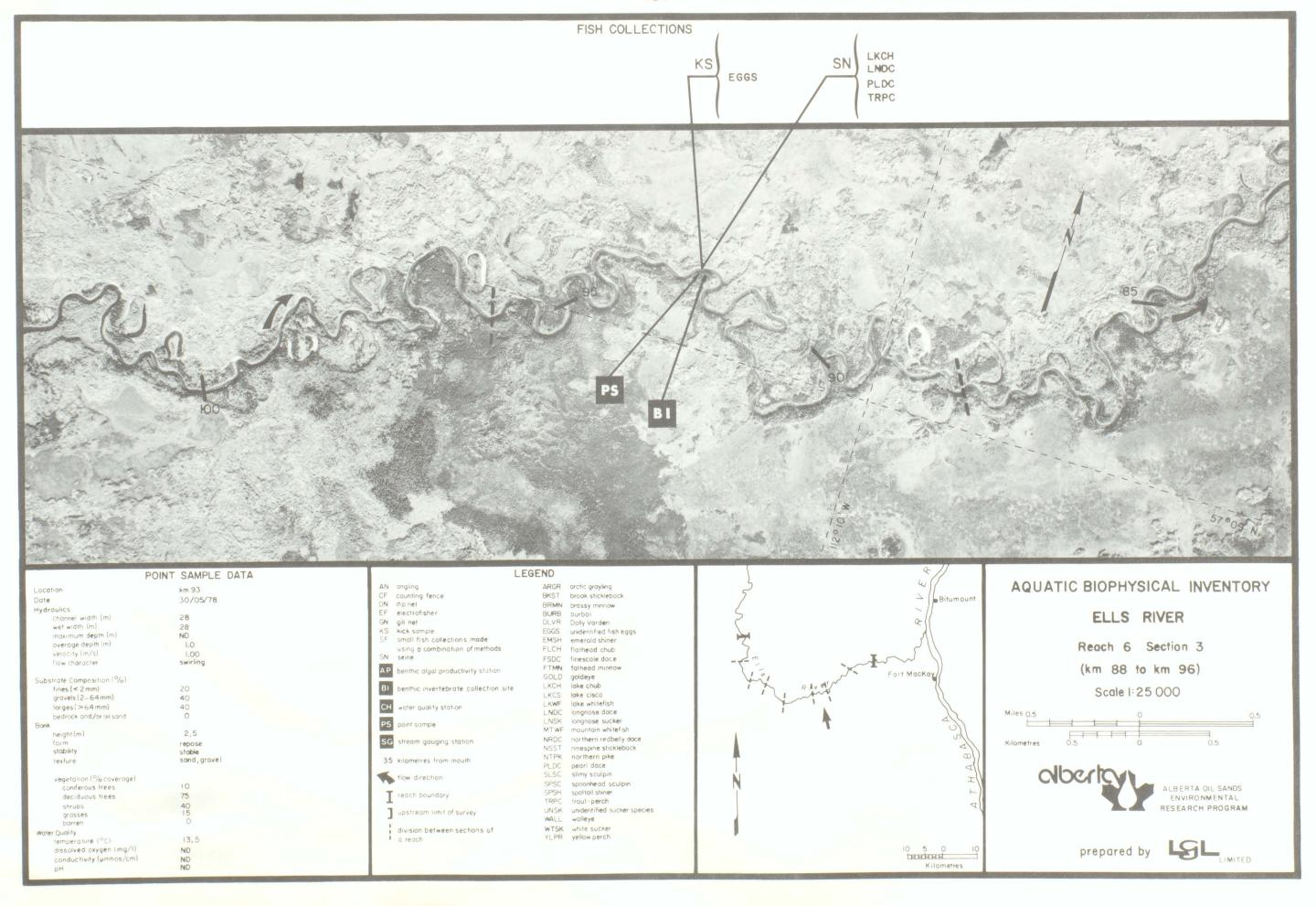
Reach 6 (km 51 to km 174)

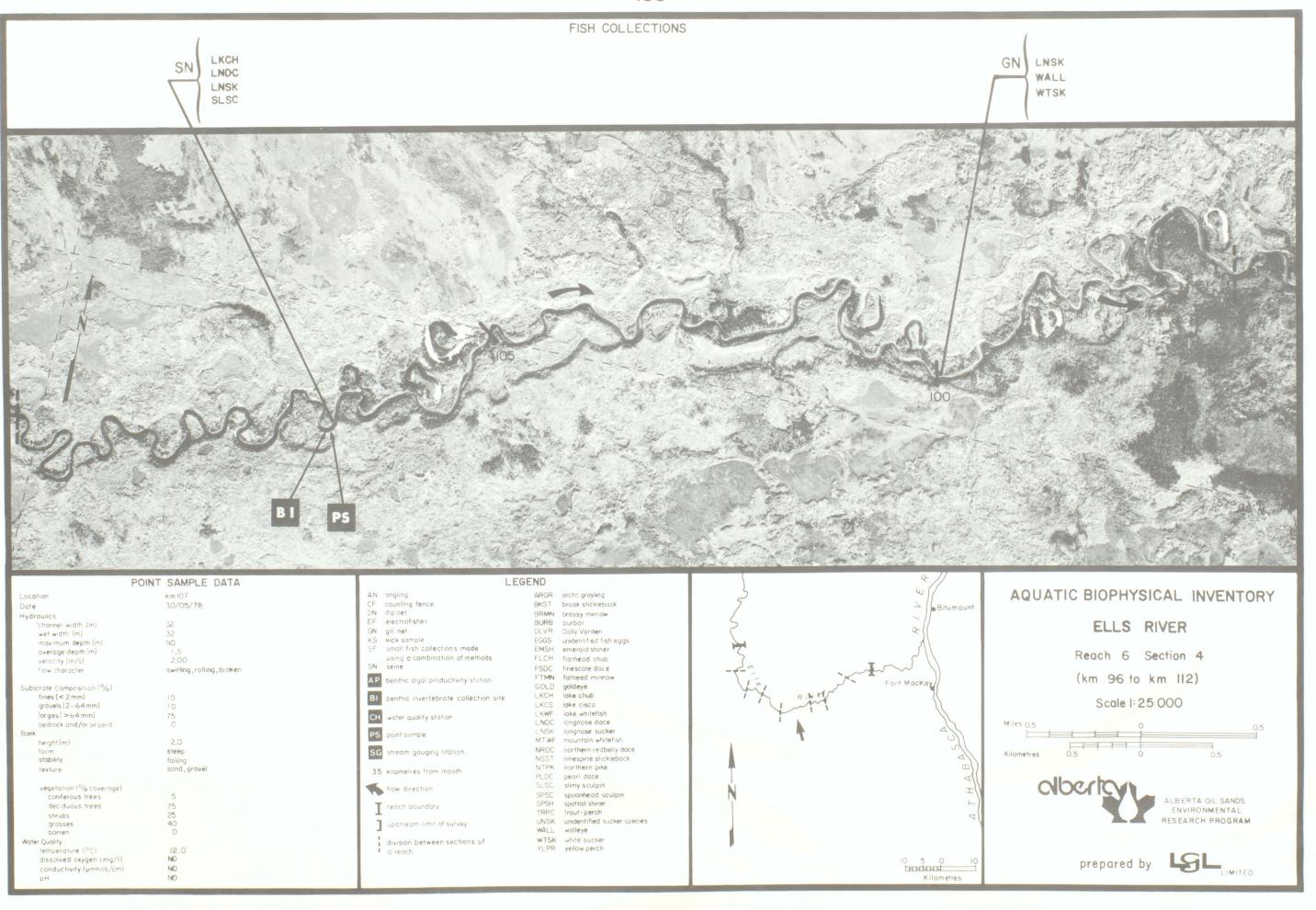


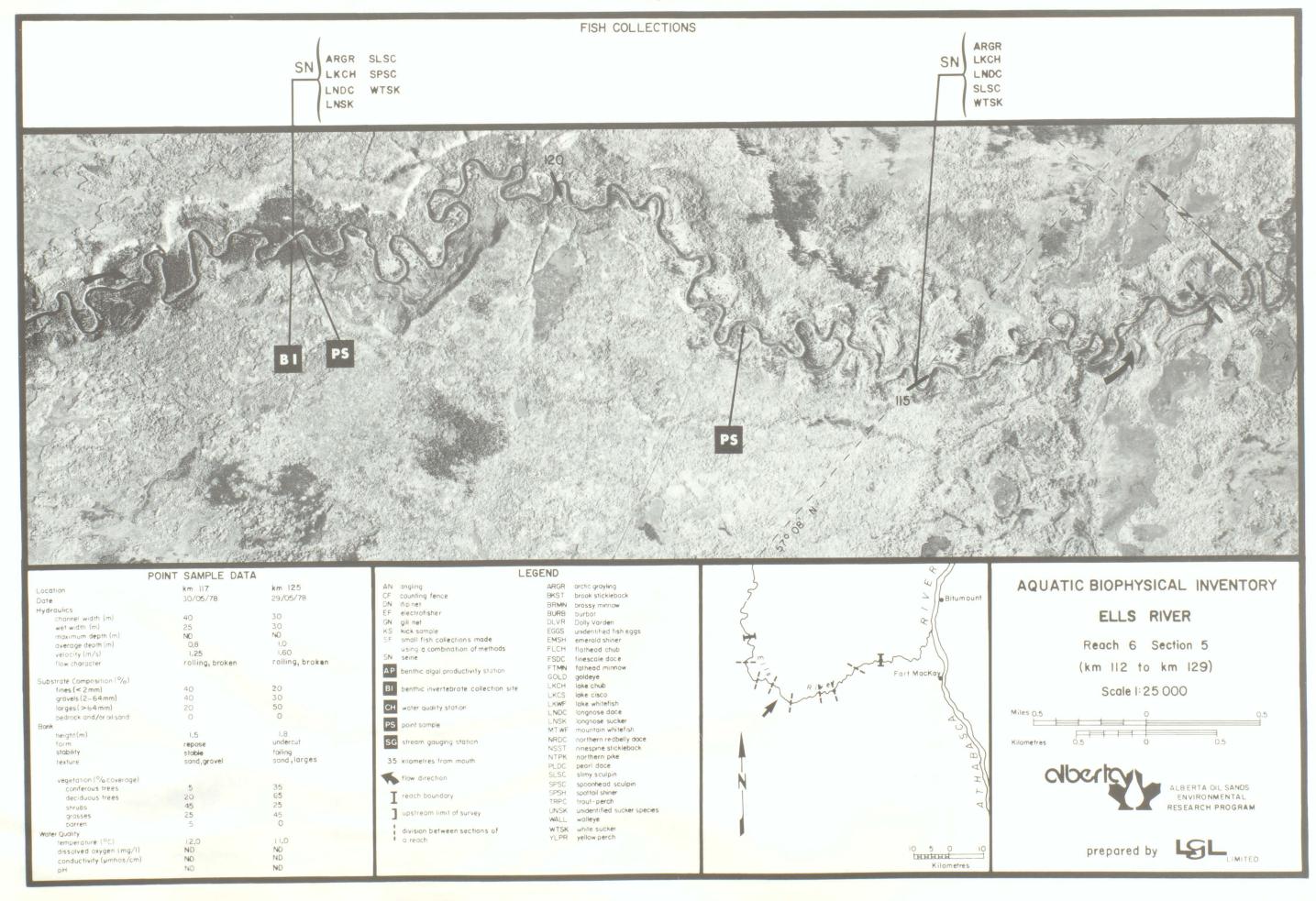


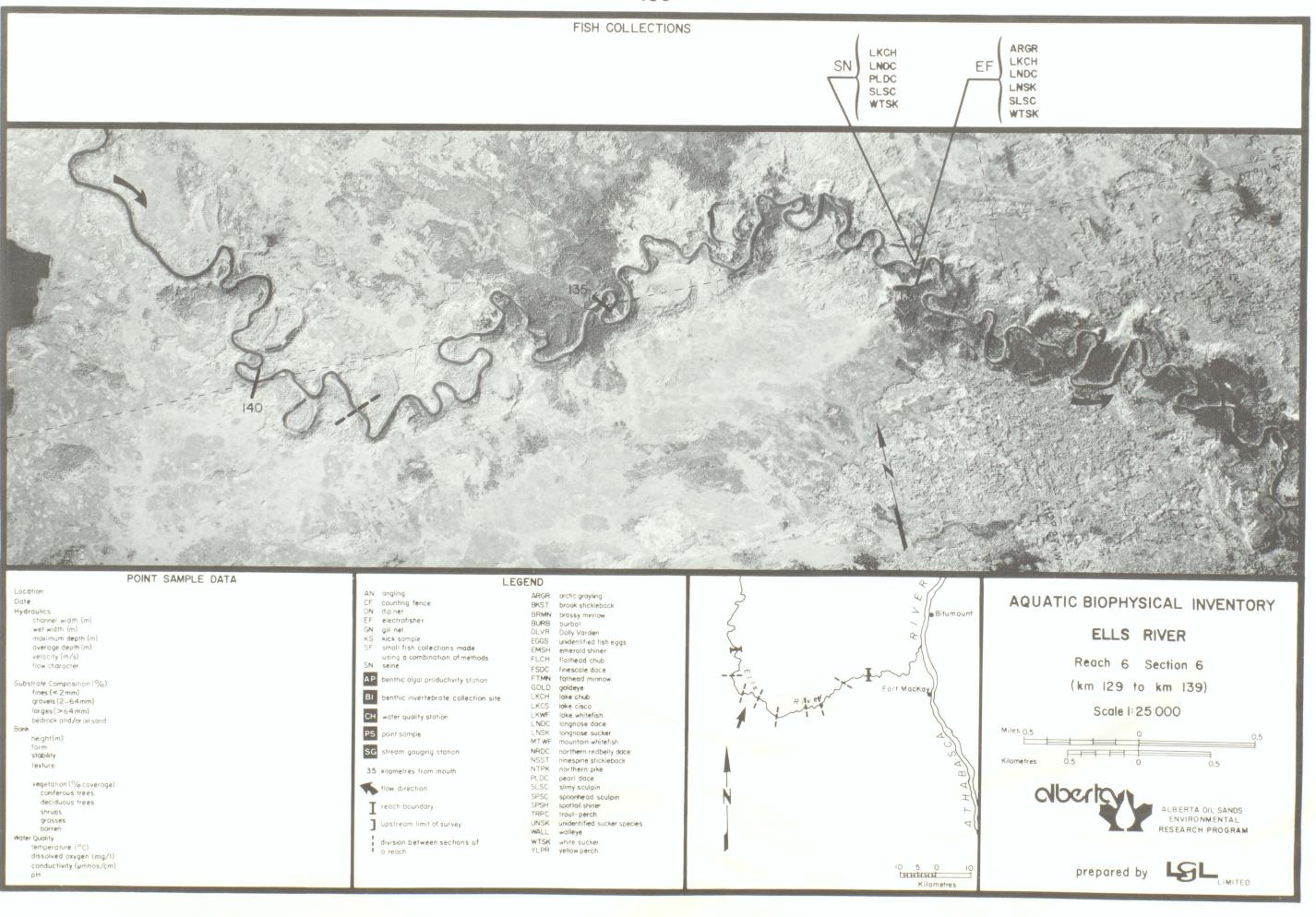


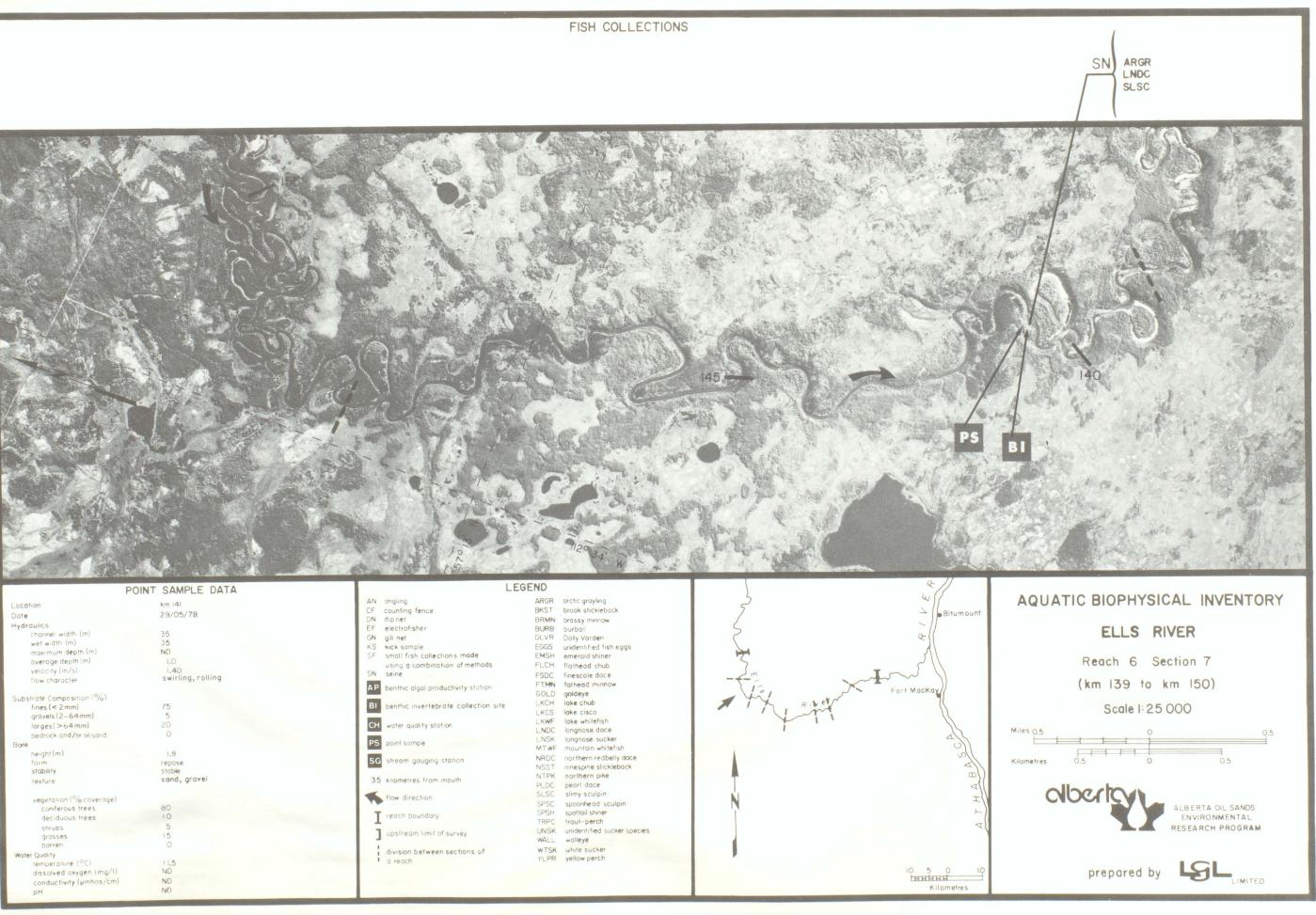


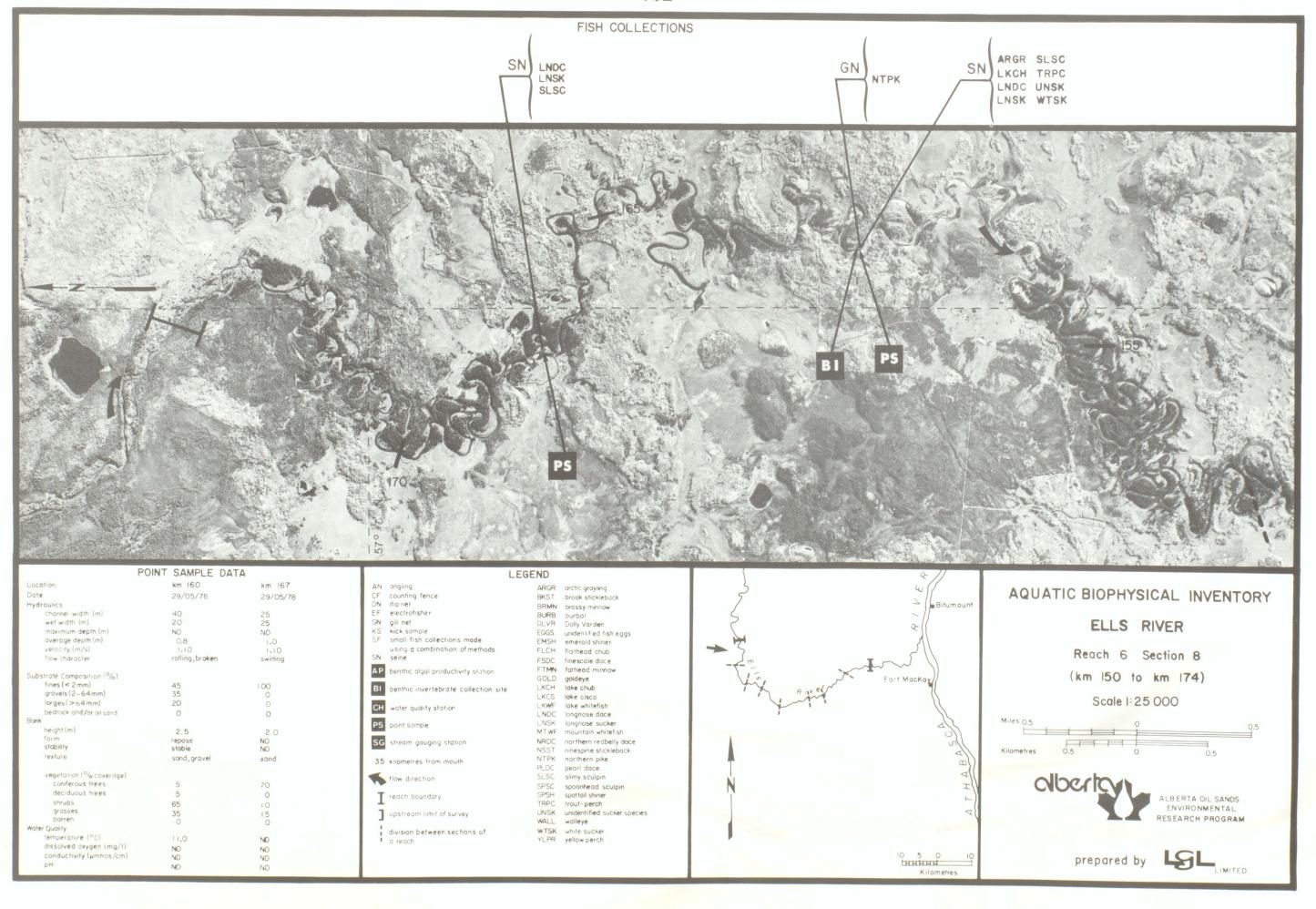












#### NUMBERS OF FISH CAPTURED (1978)

Species	Adults		Juveniles and Young-of-the-year		Total Numbers	
	June	September	June	September	June	September
arctic grayling	0	0	3	1	3	1
lake chub	0	0	3	0	3	0
longnose dace	0	0	3	0	3	0
longnose sucker	0	0	15	0	15	0
slimy sculpin	0	1	4	5	4	6
white sucker	0	0	34	0	34	0
Total	0	1	62	6	62	7

#### PHYSICAL CHARACTERISTICS

Reach length (km)	6.0
Channel width (m)	20
Channel area (ha)	12.0
Gradient (m/km)	7.2
Flow character	rolling, broken
Total pools (%)	20
Pattern	irregularly meandering
Confinement	confined
Unstable banks (%)	10
Substrate composition (%)	
fines (<2 mm)	15
gravels (2-64 mm)	40
larges (>64 mm)	40
bedrock and/or oil sand	5
Debris	moderate

#### REACH DESCRIPTION AND FISH UTILIZATION

This section is a short, irregularly meandering reach that is predominantly broken riffles and white water rapids. Both the gradient and the water velocities are the highest recorded within the surveyed portion of the Ells River. The average water depth is shallow. Larges and gravels are the predominant substrate materials, but fines are also found in numerous areas within the reach. Deciduous trees and shrubs are the most abundant vegetation types along the river bank, but coniferous trees also comprise a significant proportion of the riparian vegetation. A small amount of vegetation overhangs the channel.

The diversity of water depths, water velocities, and substrate sizes in this reach provides a number of areas that may be suitable for spawning of several species of fish, particularly those that normally spawn over rocky substrates. In many areas, however, the water velocities may be too high for spawning to occur. Moderate quantities of debris and rocky substrates provide moderate to good rearing areas for most fish species, but high water velocities throughout most of the reach may limit the rearing potential. Resting and feeding potential for larger fish is considered poor to fair. Some overhanging vegetation and moderate quantities of debris provide a number of sheltered areas, but very few pools exist for larger fish to inhabit. The generally shallow water depths and the limited number of pools preclude significant overwintering of fish in this reach.

#### BENTHIC INVERTEBRATES CRUSTACEA Amphipoda

Hyalella azteca INSECTA Ephemeroptera

Odonata Ophiogomphus Trichoptera Cheumatopsyche

Hydropsyche Lepidostoma Coleoptera Elmidae Diptera Tipulidae Chironomidae Chironominae Orthocladiinae Simuliidae Tabanidae

#### RIPARIAN VEGETATION

Bank coverage (%) 20 Coniferous trees 50 Deciduous trees Shrubs Grasses Barren Channel cover (%) Overhang Crown

#### BENTHIC ALGAL PRODUCTIVITY

No data available for this reach

#### STREAM GAUGING DATA

No data available for this reach

#### WATER QUALITY

No data available for this reach



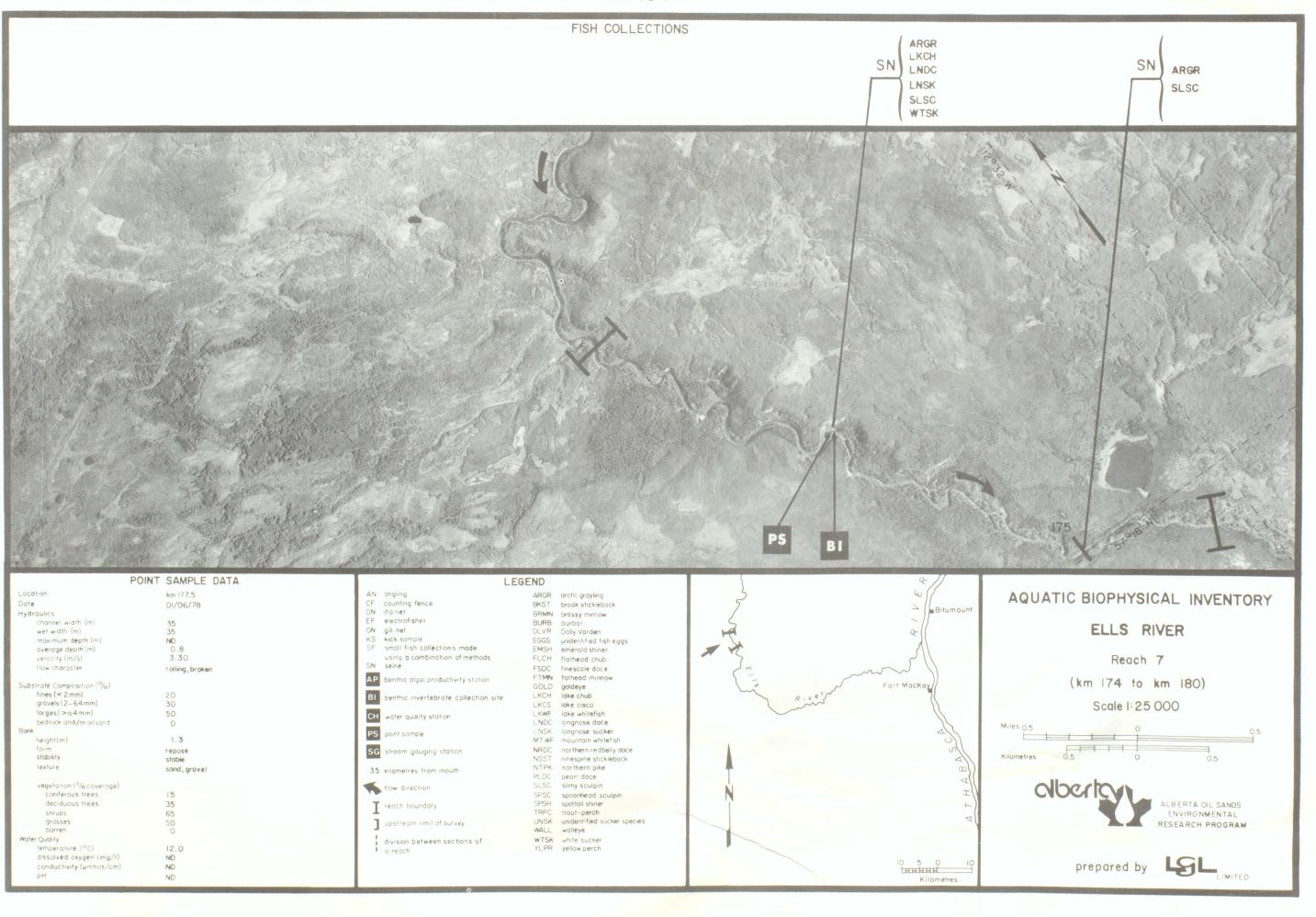
A typical area of reach 7 at km 177.5.

## AQUATIC BIOPHYSICAL INVENTORY ELLS RIVER

Reach 7 (km 174 to km 180)







	Adults		Juveniles and Young-of-the-year		Total Numbers	
Species	June	September	June	September	June	September
arctic grayling	0	0	4	0	4	0
lake chub	0	5	6	3	6	8
longnose dace	0	0	14	38	4	38
longnose sucker	0	0	99	32	99	32
northern pike	0	2	0	1	0	3
slimy sculpin	3	0	6	0	9	0
unidentified suckers	0	0	1	32	1	32
walleye	0	0	.0	1	0	1
white sucker	0	0	134	19	134	19
Total	3	7	254	126	257	133

#### PHYSICAL CHARACTERISTICS

Reach length (km)	13.0
Channel width (m)	30
Channel area (ha)	39.0
Gradient (m/km)	5.0
Flow character	swirling, rolling, broken
Total pools (%)	50
Pattern	irregularly meandering
Confinement	confined
Unstable banks (%)	5
Substrate composition (%)	
fines (<2 mm)	15
gravels (2-64 mm)	25
larges (>64 mm)	60
bedrock and/or oil sand	0
Debris	moderate

#### REACH DESCRIPTION AND FISH UTILIZATION

This section is the most upstream reach of the surveyed portion of the Ells River. The gradient is relatively high and the flow character is mixed, varying from swirling to rolling to broken. Approximately half of the total reach area is composed of pools and the water is moderately deep in many areas. Large rocks and boulders are the dominant substrate materials, but significant amounts of gravels and fines are also present. The riparian vegetation consists primarily of deciduous trees and shrubs, with some scattered conifers. There is a small amount of overhanging vegetation.

The spawning potential of this reach is considered to be excellent for many of the fish species that occur in the Ells River, because of the diversity in substrate sizes, water velocities and water depths. The reach is a particularly attractive spawning area for those fish that prefer rocky substrates. Rocky substrates and moderate quantities of debris provide good to excellent rearing opportunities for most fish species found in the Ells River. Some areas along the banks that are shaded by overhanging vegetation also provide suitable rearing habitat. Moderately high numbers of young fish, particularly white and longnose suckers, were captured in the reach during this study. Resting and feeding potential for larger fish is considered to be good, because of the numerous pools and areas sheltered by debris. Suitable overwintering areas are found in the numerous, relatively deep pools.

#### BENTHIC INVERTEBRATES GASTROPODA

INSECTA Ephemeroptera

Ameletus Stenonema

Odonata

Ophiogomphus Plecoptera

Trichoptera

Glossosoma Hydropsyche Lepidostoma Oecetis Polycentropus

Coleoptera Elmidae Diptera Tipulidae Chironomidae Chironominae Tanypodinae Orthocladiinae Simuliidae Tabanidae Dolichopodidae

#### RIPARIAN VEGETATION

Bank coverage (%) Coniferous trees Deciduous trees Shrubs Grasses Barren Channel cover (%) Overhang

#### BENTHIC ALGAL PRODUCTIVITY

Data from Hickman et al. (1980).

Standing crop expressed as cell counts (number  $\cdot$  m<sup>-2</sup>) mean:  $435.0 \times 10^{1}$ maximum: 702.0 x 10<sup>10</sup> minimum:  $36.0 \times 10^{10}$ Standing crop expressed as chlorophyll  $\alpha$  (mg·m<sup>-2</sup>) maximum: 84.5 minimum: 24.0 Primary productivity (mg C·h<sup>-1</sup>·m<sup>-2</sup>) mean: 20.6 maximum: 52.5

#### STREAM GAUGING DATA

Water Survey of Canada station number 07DA010

Maximum total annual discharge: 203.5 x 10<sup>6</sup> m<sup>3</sup> (1978) Minimum total annual discharge:  $108.4 \times 10^6 \text{ m}^3$  (1977) Maximum annual mean discharge: 6.46 m<sup>3</sup>/s (1978) Minimum annual mean discharge: 3.43 m<sup>3</sup>/s (1977) Maximum monthly mean discharge: 25.46 m<sup>3</sup>/s (July 1975) Minimum monthly mean discharge: 0.21 m<sup>3</sup>/s (March 1977) Maximum daily discharge: 34.83 m<sup>3</sup>/s (July 6, 1975) Minimum daily discharge: 0.20 m<sup>3</sup>/s (Mar. 15, 1977)

Data for 1975 to 1978 compiled from Loeppky and Spitzer (1977). Warner and Spitzer (1979) and Warner (1979).

#### WATER QUALITY

Water Survey of Canada station number 00AT07DA0100

Minimum
37.8 6.88
39.4
70
37
< 0.4
7.0
0.4
< 0.003
0.10
0.026
< 0.003
3.2

Data for the period January 1976 to December 1979 obtained from the National Water Quality Data Bank (NAQUADAT).

# We will be

Ells River at km 185.5.

# AQUATIC BIOPHYSICAL INVENTORY

ELLS RIVER

Reach 8 (km 180 to km 193)





